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PARATHYROIDISM*

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THE most interesting recent surgical publications in the endocrinological field have been the observations on tumors of the pancreas, or better, of the islands of Langerhans, causing hyperinsulism, certain tumors of the suprarenals causing paroxysmal high blood pressure and tumors of the parathyroids responsible for various osteomalacic processes. All three conditions caused by tumors or states of hyperfunction of these tissues are curable by removal of the tumors, or the over-active endocrine organs involved.

This paper will discuss a group of cases of hyperparathyroidism. Just as exophthalmic goiter is considered to be due to an exaggerated thyroid function and myxedema to hypothyroidism or lessened function of the gland, so we have learned that the parathyroids are, in a like manner, responsible for two clinical conditions. If the parathyroids are injured, as sometimes happens in the course of a goiter operation, a complex of symptoms follows which is known as tetany. If the parathyroid action is stimulated by tumor formations or other pathological processes in the gland, a complex of symptoms follows now called hyperparathyroidism. It is characterized mainly by interference with the calcium content of bones. Myxedema and tetany are both treated successfully by extracts of the respective glands. The hyperactive states of both glands seem to be treated best by surgical removal of tumors of the two glands, or by partial excision of the gland tissue. The comparison between these two organs can be carried on indefinitely. Over-feeding with thyroid extract will cause an abortive picture of an exophthalmic goiter. Giving large doses of Collip's parathormone will cause a mild degree of osteomalacia comparable to that seen in parathyroidism.

In exophthalmic goiter, as now in parathyroidism, surgeons were at first afraid to remove too much of the gland, fearing postoperative myxedema, or postoperative tetany, respectively. Now we learn that such postoperative deficiency symptoms can be prevented by the use of thyroid or Lugol's solution in the case of the thyroid and the same can be accomplished by parathormone after parathyroidectomy. This comparative endocrinology is a most interesting study.

Quite definite clinical pictures result from the "hyper" and "hypo" function states of all the important endocrines. In general the hyperfunction states have been up to now best attacked by surgical measures, and the hypofunctions by various extracts of the glands. The hypophysis seems to be an exception, in that surgical measures are not yet applicable to either acromegaly or Froelich's syndrome; but the overactivity of the insulin islands or adenomata of the insulin tissue resulting in hyperinsulism, has been successfully treated surgically. The epileptoid or collapse states accompanied by hypoglycemia have several times been cured by surgical

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removal of the offending pancreatic tissue (McAlenahan and Norris, Wilder and Finney).

Adrenal cortex hyperplasia and hypertrophy or true neoplasms of the cortical interrenal tissue give a characteristic clinical expression by causing paroxysmal hypertension, increased muscular activity, and stimulation of the sexual function. Patients having these conditions have been successfully operated upon and cured by removal of the adrenal adenomata. This condition represents the reverse of the hypofunction state known as Addison's disease (Mayo, Shipley, Porter).

Parathyroidism seems to be very frequent. Practically every journal of endocrinology or surgery now brings some report on cases of parathyroidism. In our own experience, we have 2 cases which were autopsied, showing the association of bone defects with parathyroid tumors. We performed during the last year, 5 parathyroidectomies, with improvement of the osteomalacic symptoms, and we have at least 20 other cases which clinically belong to this group. There is no doubt that this is a relatively frequent condition and that many people suffer from the lesser degrees of parathyroidism.

Parathyroidism is characterized by:

1. General skeletal disease with disappearance of lime salts from the bones generally and also in circumscribed areas, heretofore called osteitis fibrosa cystica.

2. Severe pains in the affected bones, especially the spine; elevated serum calcium, increased calcium excretion, reduced serum phosphorus and elevated phosphorus excretion.

3. Lessening in height of the patient due to compression of the vertebrae, curving of the long bones, and sometimes multiple pathological fractures.

As to the history of parathyroidism, Langendorf and Mommsen in 1877 and especially Virchow in 1886, gave very good pictures of osteitis fibrosa cystica, mentioning shortening of the patient's skeleton and softness of the bones and the localized areas of so-called osteitis fibrosa cystica. Virchow especially stressed the point that these areas were not sarcomas, but areas of softening and not neoplastic in character. Von Recklinghausen in 1891, in a Jubilee Volume for Virchow, described osteitis fibrosa cystica, and Askanazy in 1904 first mentioned the association with parathyroid tumor.

Erdheim in 1907 connected the two findings etiologically in the publication of 3 more cases. In 1925, Hoffeinz collected 25 cases of osteomalacias with parathyroid tumor and Mandl in the same year, for the first time, successfully removed a parathyroid tumor, affecting a clinical cure of the condition. Since then about 20 cases of parathyroidectomy have been published where the calcium returned into the bones generally, and the fractures healed in the regions of the osteitis fibrosa cystica. There was immediate cessation of the severe bone pains after operation.

Early in 1930 Donald Hunter published an exhaustive discussion of the various clinical and pathological states associated with defects in calcium content of bone together with an exhaustive review of the question of calcium and phosphorus metabolism and the relation of the parathyroid function to the matter. Hunter's general conclusions are that the diffuse or multiple type of osteitis fibrosa cystica is definitely associated with parathyroid hyperfunction, usually a tumor-like hypertrophy or adenoma of one of the parathyroid bodies. In these cases it is the rule to find high blood calcium and low blood phosphorus with increased urinary excretion of both. On the other hand, Hunter regards osteomalacia, properly so called, and rickets, as essentially the same disease and different in etiology and pathogenesis from the osteitis fibrosa cystica associated with parathyroidism. He points out the seasonal and endemic features of osteomalacia and its relation to diet, to pregnancy and ovulation, and to irradiated ergosterol. He suggests that calcium and phosphorus by mouth along with appropriate dosage

with ergosterol leads to a cure, and does not by inference consider operative interference with parathyroids indicated in true osteomalacia.

Hunter recognizes the uniform occurrence of parathyroid hypertrophy in true osteomalacia, but regards it as compensatory or reactive in nature and not primarily responsible for the bone changes. We quote him as follows: "Osteomalacia therefore chemically resembles low calcium rickets. In the present state of our knowledge the occurrence of hyperplasia of the parathyroids in osteomalacia is without explanation. Since all parathyroids are usually affected the hypothesis that the change is compensatory seems attractive."

This author disposes of osteitis deformans or Paget's disease with the statement that Kay has found the serum phosphotase increased, but does not discuss a possible parathyroid relationship.

In osteogenesis imperfecta, the serum calcium, plasma phosphorus, and calcium output is normal. Hunter states, however, that Bauer and Dietrich have found enlarged parathyroids in this condition. In renal rickets there is a disturbance of endogenous calcium and phosphorus metabolism, probably on a nephritic basis. Hunter does not mention abnormalities of the parathyroids in this condition, although our autopsied case (vide infra) showed a huge hypertrophy of one of the parathyroid bodies. It would seem, then, that Hunter considers generalized osteitis fibrosa cystica with high blood calcium and low blood phosphorus to be fairly constantly associated with parathyroid adenomata, and to represent a true or primary hyperparathyroidism, justifying operative interference, but that most of the other states he regards as of other origin and considers the parathyroid hypertrophy to be of compensatory nature. Considering the high phosphorus retention of chronic nephritis and the fact that hypertrophy of the parathyroids is known to result from artificial production of a phosphotemia in young animals, it occurs to us that possibly our parathyroid findings and the bone softening may result from this cause in renal rickets.

The clinical condition, which will probably keep the name of parathyroidism, (this will do just as well as the longer word, hyperparathyroidism) seems to become more and more established as a true entity. The affection starts at times as an isolated painful spot in the long bones, metacarpus, metatarsus, or most usually in the spine. A middle-aged patient will complain of backache, constantly increasing in severity, and that he is getting shorter. His head is sinking between his shoulders, his legs are becoming bowed, the costal arches approach the spine of the ilium more and more. The roentgenogram reveals a general deficiency of lime content of the bones. The plates look as though they were poorly taken, due to decrease of the shadow-giving calcium; and between this general demineralization, there is discovered here and there in the skeleton, areas with total absence of lime, resembling cystic formations (osteitis fibrosa cystica). In the long bones, tumor-like soft tissue swelling replaces the osseous tissue in irregular round or oblong areas and the vertebrae shrink in height and collapse. Severe pain in the affected bones ensues. Generally these pains are treated first with corsets to support the painful and stooped spine. The diagnosis of metastatic malignancy usually prevails until the duration of the symptoms makes this diagnosis untenable and further study reveals the parathyroidism. Studies of the calcium content of the blood render the diagnosis more convincing.

People around mid-life are mostly affected, but there are also some infantile cases reported beginning at about the age of eight to ten years. Whether the two are entirely of the same character remains to be seen. We know of 3 cases where the affection started in childhood.

For illustration it seems best to give some instances of our own observations and we shall choose those which were

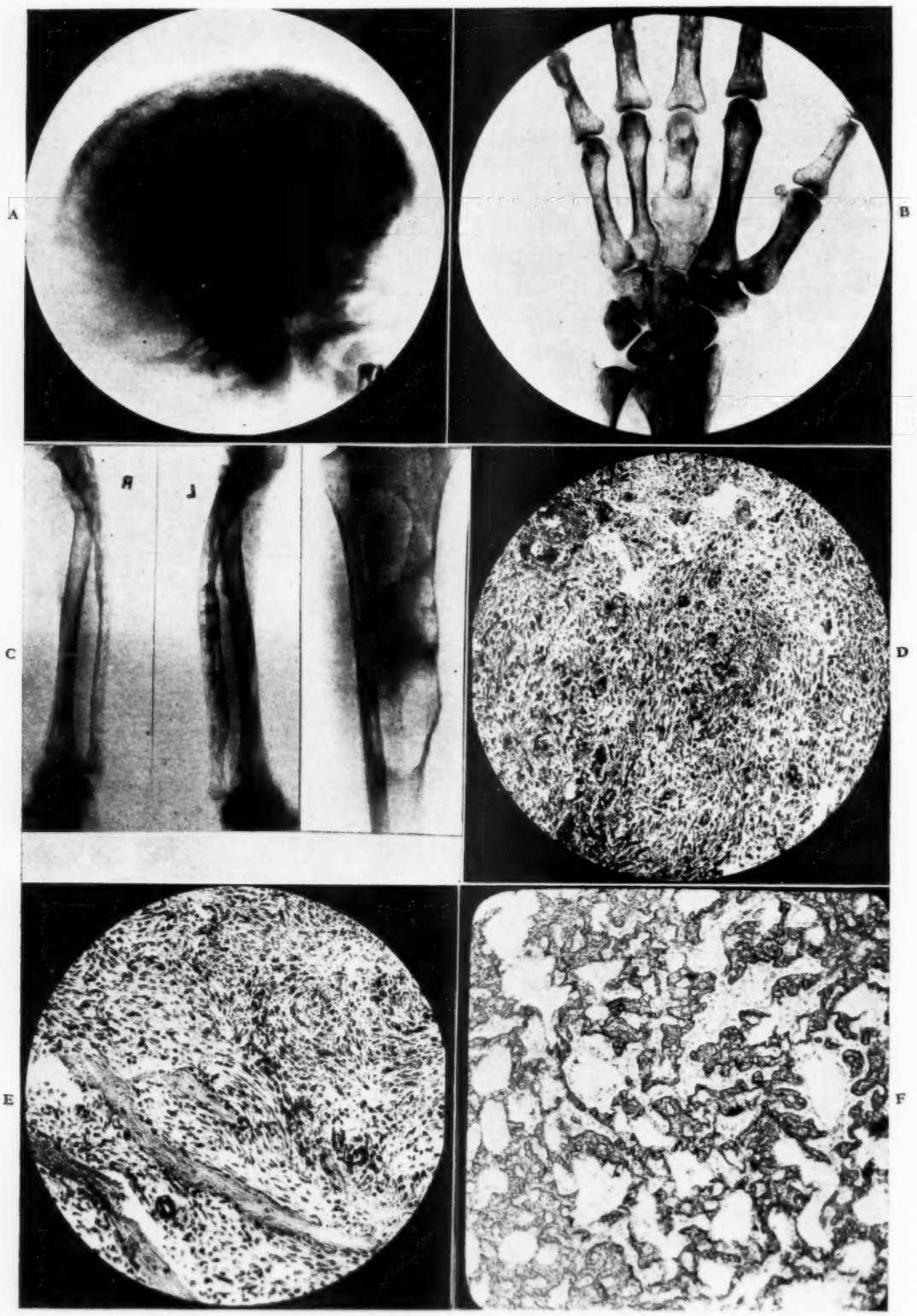
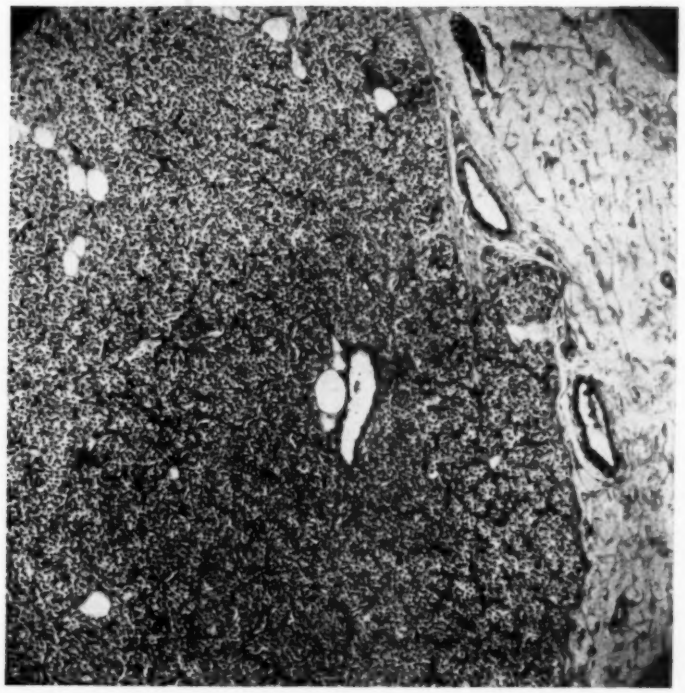


FIG. 1. Case 1. A. Skull cap demineralization. (Paget's disease of the skull.) B. Osteitis fibrosa cystica area in metacarpus. C. Osteitis fibrosa cystica in forearms and lower leg. D. Osteitis fibrosa cystica in cellular area resembling giant cell tumor. E. Osteitis fibrosa cystica; osteoid, fibrous area. F. Parathyroid tumor found at autopsy.



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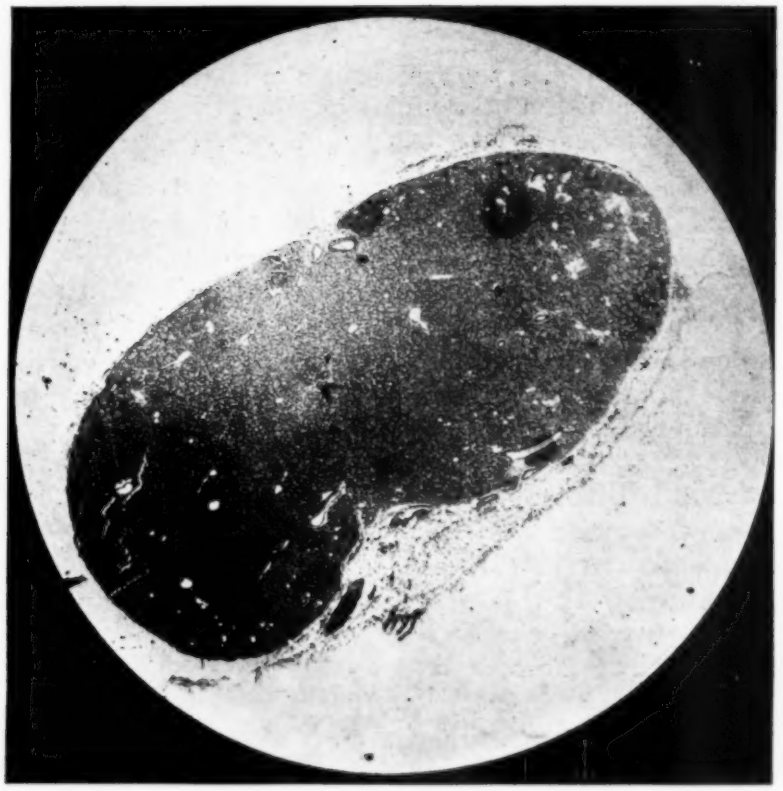


B

FIG. 2. Case II. Parathyroid hypertrophy in case of renal rickets.

proved to be of parathyroid origin, either by autopsy or operation.

Case I. M. B. born November 19, 1875. In 1914 a swelling on the left forearm was noticed. Then followed swelling along the ribs. In 1915 the patient was unable to walk and had to use crutches, with much suffering from pain in the spine and legs. A cyst formation in the forearm was discovered in 1914. Other foci of osteitis fibrosa cystica were found in the legs. Arms as well as the legs were operated upon, and bone cyst scraped without influencing the process. A large fibroid was also discovered in 1920. She died in 1925 from an intestinal obstruction, the exact nature of which was not revealed.

Autopsy showed all bones very much thickened, irregularly deformed; the long bones showed bowing, could be bent like sole leather and cut easily with a knife. The cystic areas contained brown material, usually bleeding and sponge-like. The normal structure on other places was replaced by yellowish gray fibrous tissue. The periosteum was very thick. The skull cap was ½ in. thick, cut easily with a knife, and the layers of the skull could not be differentiated. The left parathyroid contained a tumor.

Comment: In this case, the affection started as mentioned before, and as so often happens, as an isolated swelling of osteitis fibrosa cystica in the left forearm, followed later on by multiple foci in the ribs, pain in the spine and legs and general demineralization with many cystic areas in the bones. The skull cap could be cut with a knife, which also was true in the second autopsy case. A parathyroid tumor in this case was not suspected before death, and was only discovered at autopsy. Repeated attempts were made with this patient prior to 1925 to produce a positive calcium balance by feeding calcium lactate and calcium chloride without success. Repeated curettements of affected areas were without success in causing bone formation.

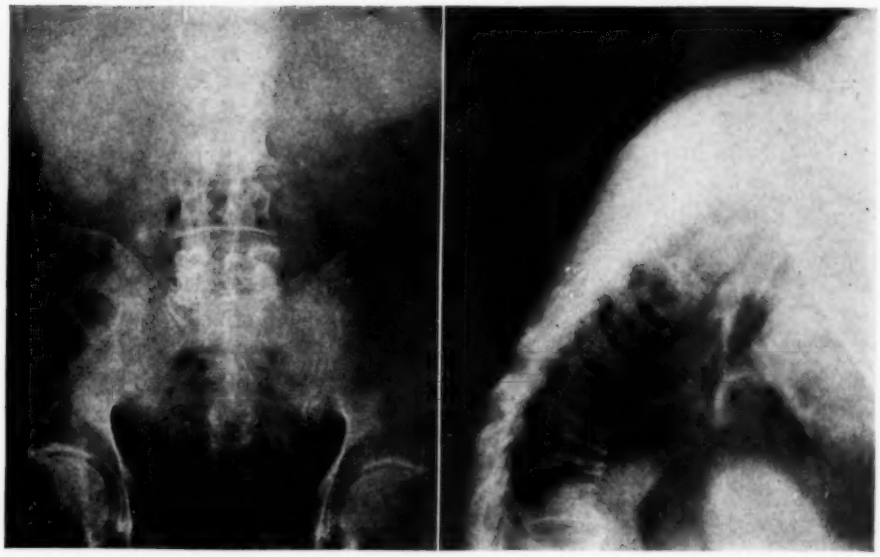
Case II. E. H., aged seventeen, admitted to Harper Hospital on September 4, 1930, died September 13, 1930. His chief complaints were weakness, loss of weight, anemia, and fever. From the physical examination we mention the following: High blood pressure for his age, 178/92, deep brown discoloration of the skin, systolic murmur at heart, slight enlargement of the liver and spleen, hypospadias, with scars of several operations, precordial frictional rub, oliguria with albumin, red and white blood cells, hyaline and granular casts in the urine, and very high blood nitrogen. The case corresponds clinically to the condition known as renal rickets. The clinical diagnosis of this case was hypertensive nephritis. The bone lesions were unsuspected and no *x*-ray examination or calcium or phosphorus estimations were made. The true nature of the case with the bone softening and parathyroid hypertrophy was found at autopsy.

On autopsy the most striking finding was the softness of the bones, the skull and cranium could be cut with a knife, and again there was a generalized hypertrophy of the parathyroids, extraordinaryhyperplasi a of eosinophils and basophils in the pituitary and extreme arteriolar degeneration of the kidneys (Jore's type). Pemberton and Geddie published practically an identical case in a girl fourteen years old with calcium deficiency in the bones and finding of an adenoma of the left lower parathyroid body. Also this case was complicated with polyuria and slight albuminuria.

Comments: Besides this case, we have two more observations (Cases I and VI) where the disease started early in life. Whether this type of parathyroidism is entirely the same affection as that usually coming on at mid-life remains to be seen, but appears likely.

Case III. J. B. came under the observation of our associate Dr. R. C. Moehlig in 1927, when he was about sixty-five years old. The patient noticed that he was stooping over, had severe pain in his spine so that he had to take opiates. *X*-rays showed a destructive process; the bodies of the vertebrae diminished in height, and there was general decalcification so that the bones did not stand out well. A diagnosis of metastatic malignancy was made at first, but the process went on for three or four years, without much change except that the pain became much more severe and more bones became affected. Dr. Moehlig diagnosed the case as parathyroidism. The patient was operated on by Dr. Ballin on May 31, 1930.

Figure 3, D, E, and F shows the parathyroid



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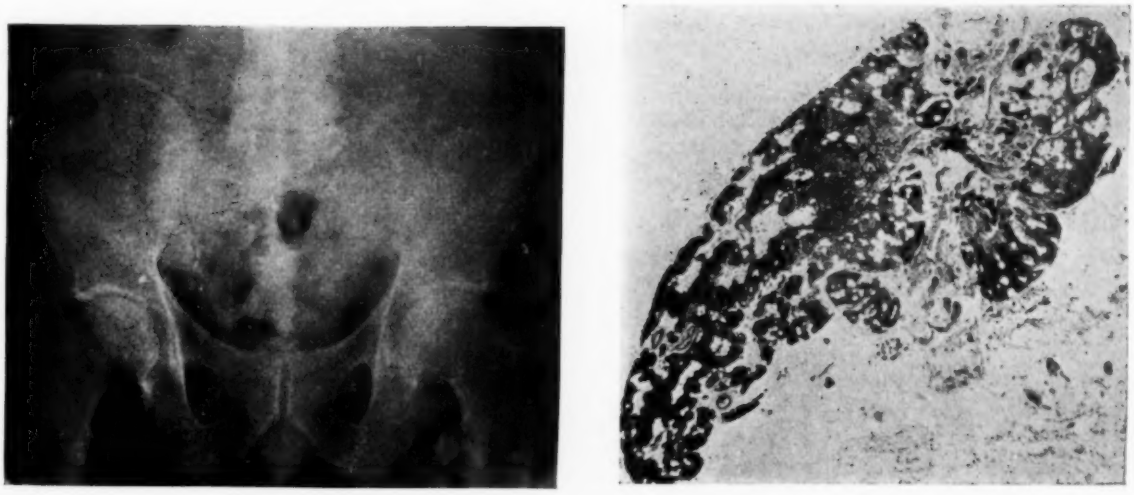
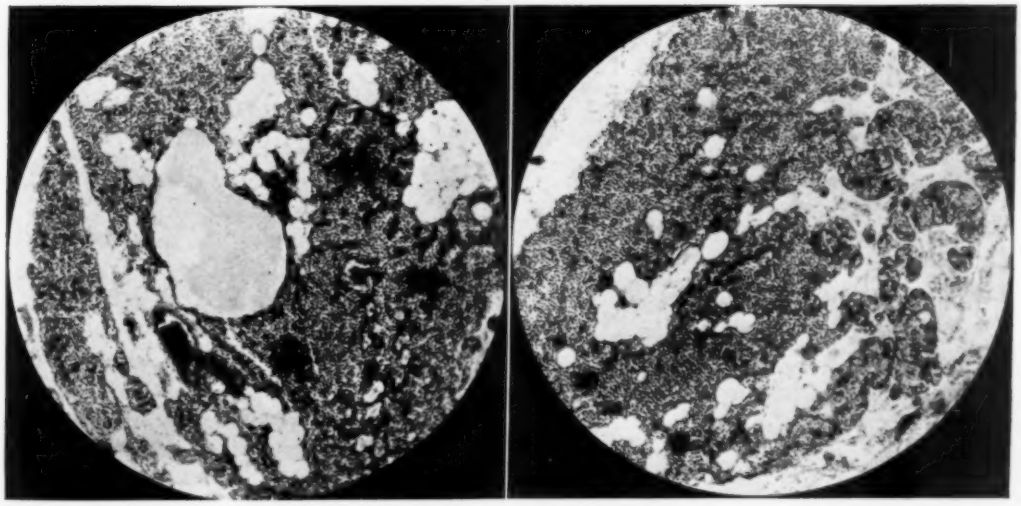


C D

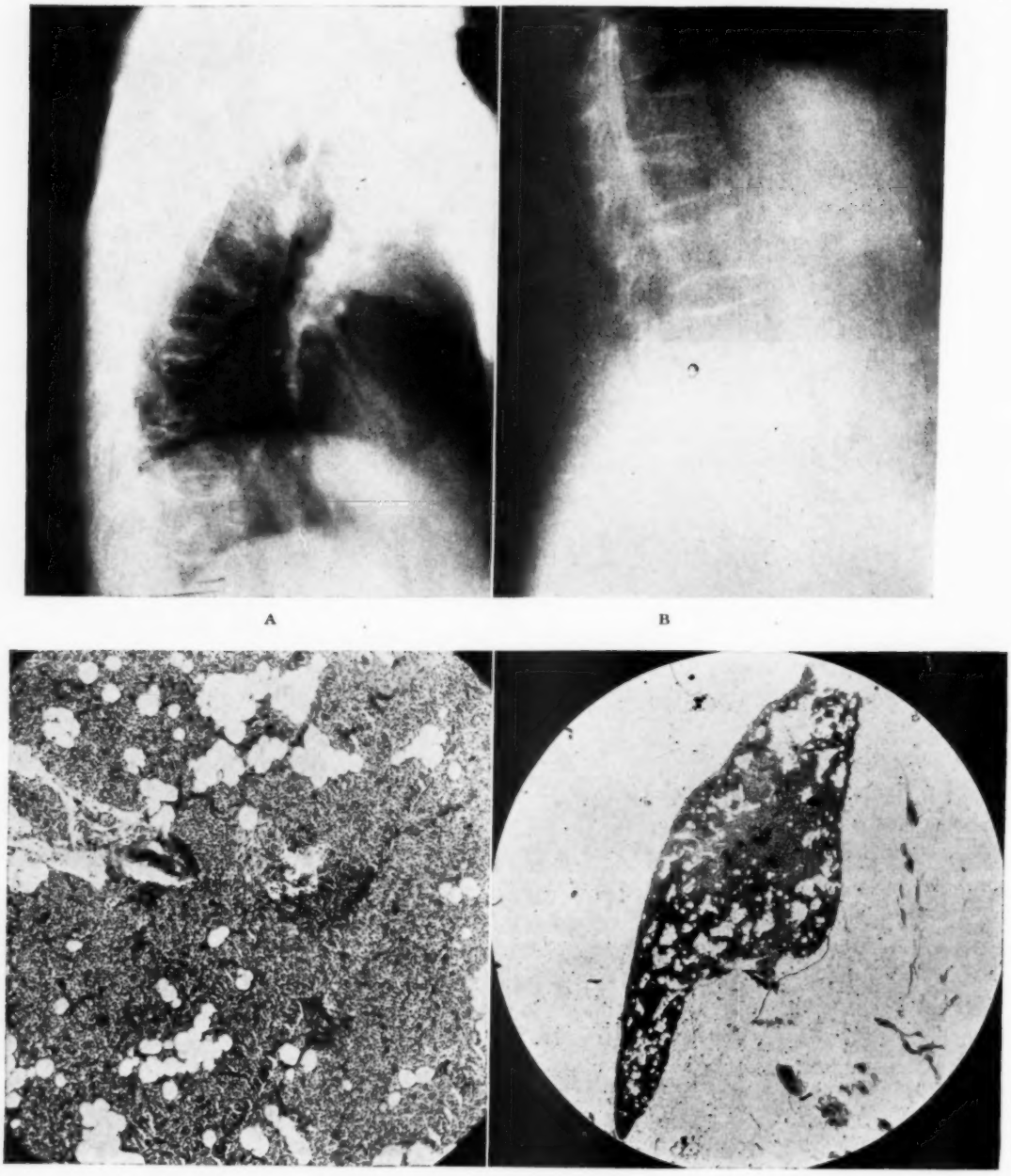


E F

FIG. 3. Case III. A. Collapsed vertebrae before operation. B. Collapsed vertebrae before operation. C. Calcium coming back into bones, four months after operation. D, E and F. Microphotographs of the parathyroid bodies removed.

tissue removed. Figure 3c shows the calcium coming back in the bones, four months after the operation. The pain has practically disappeared so that the man does not need opiates any longer. The stooping is no longer progressive but is stationary.

Comment: The case of Mr. B. is very interesting and shows the typical history of a patient becoming at first weak, then getting backache, becoming stooped, and then *x*-ray evidence of a destructive process in the vertebrae is found. In practically every case the condition is first considered malignant metastasis. No primary malignancy can be found and finally parathyroidism is thought of. It is quite characteristic that in all cases, at least those in mid-life, some arthritic process of the spine and sacroiliac joint is first claimed, but the usual support of the



A B C D

Fig. 4, Case iv. A Collapsed vertebrae. B. Collapsed vertebrae. C. Parathyroid body with round cell infiltration. D. Parathyroid body, low power.

sacroiliac joints and spine does not give results. The calcium readings are frequently normal at times, but then again we get readings of 14.0 and 16.0 and this confirms the diagnosis. The parathyroids do not have to form actual tumors (adenomas). A simple hyperplasia is sufficient to produce the picture.

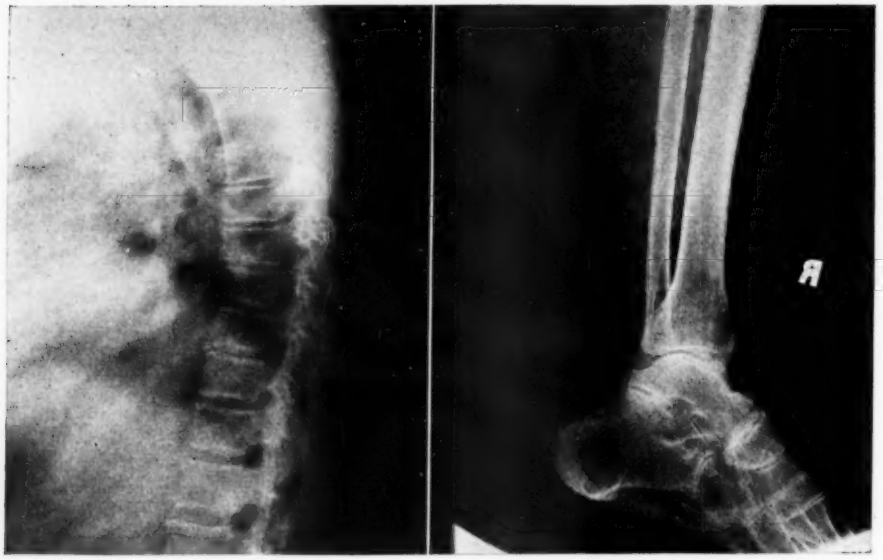
Case IV. The case of Mr. R. C. is practically identical with the preceding case. This man, who was healthy all his life, began to complain of pain, which was first called sacroiliac distress. Some hypertrophic arthritis was found in the *x*-rays, for which he had some teeth extracted. The process progressed clinically as well as in the *x*-ray findings. Five months after the onset, the arthritic process was found in the thoracic and lumbar vertebrae and in addition a generalized osteoporosis. At two hospitals the diagnosis of malignancy and myeloma, respectively, was made. Eight months after the onset, Dr. William Evans roentgenologist at Harper Hospital, suggested that the condition belonged to the parathyroid group. On September 13, 1930, thyroparathyroidectomy was performed by Dr. Ballin. Three parathyroid bodies were removed. The pain was influenced immediately, and now five months after the operation, the man is coming back to normal activity.

Figure 4, A and B, shows the collapsed vertebrae. Note the general compression of the vertebral bodies; they are not cone-shaped as in fractures and malignancy, and also note the demineralization. The calcium in Mr. C's case was around 12.0 to 14.0 and once was 18.0 and again 20.0 at different readings. It seems that one reading of calcium should not be the deciding factor.

Comment: Again a case in an adult, after mid-life, who complained of typical back and leg ache. The condition was first diagnosed as sacroiliac arthritis, then the changes in the vertebrae were found and the patient treated for malignancy of the spine and myeloma and was supported with a corset until the eye of an experienced *x*-ray man discovered the difference in the collapsed vertebrae, the same being not wedge-shaped as in malignancy or in fracture, but generally compressed. While not absolutely diagnostic, and subject to various exceptions, the finding of a uniformly compressed rather than a wedge-shaped or irregular vertebral disc seems to be suggestive of parathyroidism. Dr. Wm. A. Evans is to be commended in teaching us to recognize this differentiation. The pains were so severe that the patient had to take codeine for a long time. Immediately after the operation the pain disappeared, and the latest *x*-rays, six months after operation, show a return of calcium into the bones.

Case V. Mrs. M. enjoyed good health up to the age of sixty, when she complained of symptoms of thyroidism. A calcified adenomatous goiter was removed in 1927. Palpitation and the thyroidism ceased but in 1930 she showed a deficiency of calcium in the scaphoid of the right foot (osteoporosis). There was still a high metabolic rate of 25 per cent above normal. The calcium at different times was from 6 mg. to 11 and 12 mg. The patient had to walk with crutches. Later on the process extended into the spine as in the other cases. On December 13, 1930, two parathyroid bodies were removed showing on microscopical examination, typical parathyroids with cystic degeneration and some lymphoid infiltration. The operation resulted in immediate disappearance of the pain and the woman is walking again without crutches.

Comment: Again a case where the affection started in one bone. For two or three years this lady had no other symptoms but pain in the foot and osteoporosis showed in the scaphoid of the right foot. Then the backache and leg ache supervened. It is also interesting that this woman, as in nearly all our other cases, had a goiter at the same time. This goiter was removed three years before the parathyroidectomy. Hunter in his article mentions that thyroidectomy also has an influence on the calcium metabolism and will improve parathyroidism. Whether this is actually the result of the thyroidectomy or whether in removing the thyroid tissue, the parathyroids were included, remains to be seen. Anyway, this patient got her parathyroidism after the thyroidectomy.



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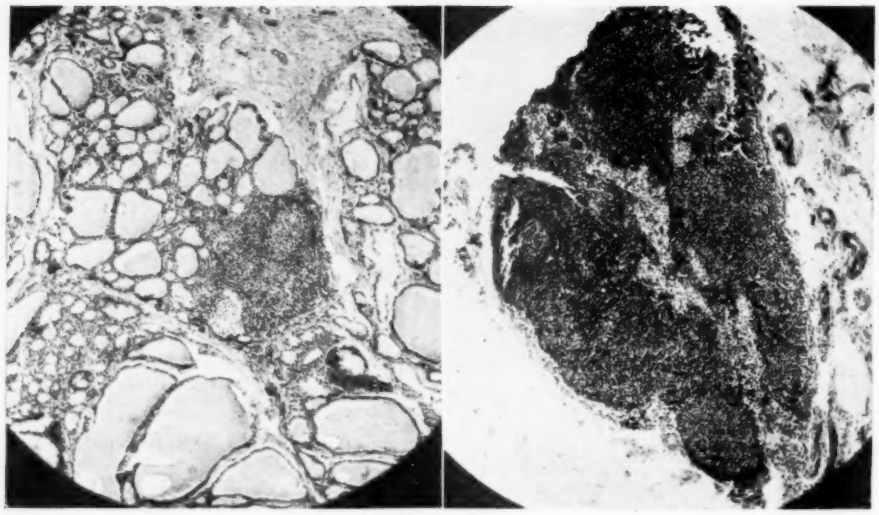

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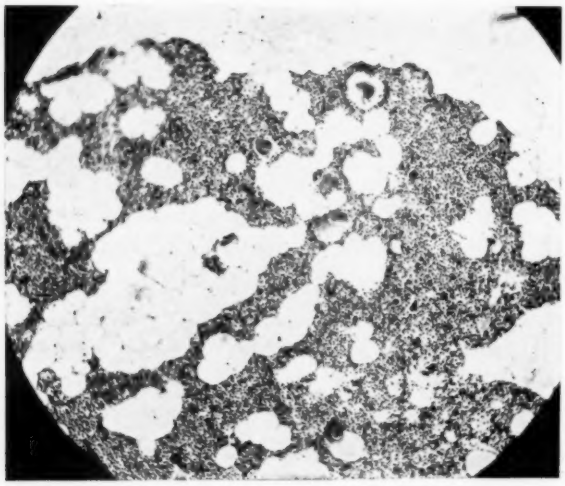

E

FIG. 5. Case V. A. Beginning crushing of dorsal vertebrae. B. Osteoporosis in scaphoid. C. Microphotograph, showing adenomatous goiter associated with parathyroid hypertrophy. D. Microphotograph of thymus enclosure in parathyroid region. E. Microphotograph of parathyroid adenoma.

Case VI. Another case, a colored woman, aged thirty, who had had an osteomalacic process (osteitis fibrosa cystica) in the femur and left pelvis since the age of ten years. The result of a spontaneous fracture can be seen in the pelvis and femur. Other pathology in the osseous system is a fracture in the left humerus, which happened without causing any great pain. This woman's pain in the hips and pelvis had been very severe for the last ten years so that she could not do her work. Parathyroidectomy gave immediate relief from the pain.

This woman at the time of operation was thirty years old, but she had her osteitis fibrosa cystica and spontaneous fracture in the femur and the pelvis at the early age of ten years. Pain in the vertebrae and back followed later on. It is to be regarded as one of the cases in early life.

Case VII. A woman past mid-life, began to get stooped and had great pain in the back. Blood calcium was 14 and 18 mg. *X*-rays showed the curvature. The removal of three parathyroids gave immediate relief of the pain.

This case is just mentioned as it shows the good result from operation. Otherwise it resembled Cases III and IV. This woman also had an enlarged thyroid gland.

In these cases, the usual symptoms of parathyroidism are evident, namely a general deficiency of lime content of the bones, with localized areas of so-called osteitis fibrosa cystica, severe pains in the affected bones, especially in the back and down the legs, also pain in the isolated areas of decalcification, and the manifestation of general and local decalcification in the *x*-ray, and by the laboratory finding of high serum calcium, and reduced serum phosphorus. Such symptoms should lead to the diagnosis of parathyroidism.

Excluded from this diagnosis should be all cases of metastatic malignancy, myeloma, and carcinoma, following cancer of the breast or prostate, etc. The radiologists point out that metastatic processes go with increased calcium content in the affected areas, where parathyroidism shows lessened calcium. Cancer metastases in the vertebrae show a triangular V-shaped compression, and the fractured vertebrae also have this shape. In parathyroidism, the whole body of the affected vertebrae is compressed and lower than the normal vertebrae.

Patients with parathyroidism usually show other endocrine stigmata, showing a general upset in the endocrine system and practically all have more or less of a goiter.

Just how much there will be left to the chapter of osteitis fibrosa cystica and Paget's disease of the bones if this whole territory belongs to the group of parathyroidism, cannot be settled until more observations are on hand. Suffice it to say that these symptoms should be an indication for a parathyroidectomy, if the symptoms are pronounced enough, and the pain sufficiently incapacitating to warrant surgery.

Feeding of lime salts and cod liver oil containing special vitamins has not proved successful for combating the symptoms but should perhaps be used in the after-care of the operated, to replace the calcium. However, replacement of calcium by feeding by mouth does not seem to increase the calcium content of bones and blood. Intravenous medication seems to be preferable.

As to the technique of the operation, the parathyroids are approached just as in goiter operations. By turning the thyroid lobe over to the opposite side careful dissection will lead down to the point where the parathyroids can be exposed between the carotid and thyroid near the inferior thyroid artery. We find pretty constantly a lower parathyroid and a little further up an upper parathyroid. Four parathyroids seem to be fairly constant. Most patients are operated on by thyroparathyroidectomy, which means that a subtotal lobectomy is done first; then the parathyroids can be better exposed and further some enclosures of parathyroid tissue in the thyroid are removed with the lobectomy. There is also the opinion expressed by many that the thyroid itself sometimes takes a part in the decalcification of the bones. Whether this is the actual function of the thyroid or due to parathyroid enclosures is still doubtful.

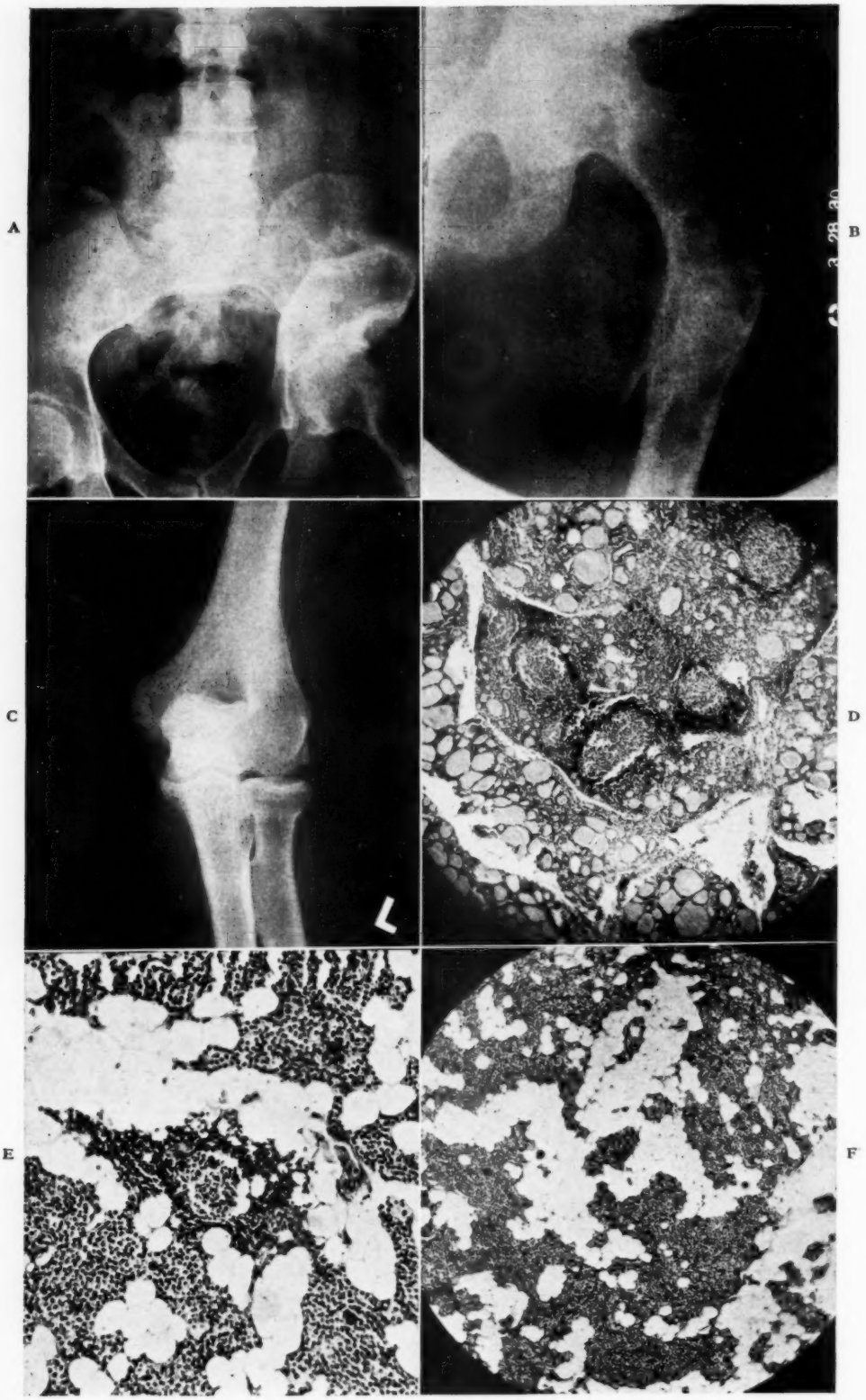

FIG. 6, Case VI. A. Pelvic bone lesions. B. Femur showing decalcification. C. Demineralization in bones of arm. D. Adenomatous thyroid associated with parathyroid hypertrophy. E and F. Parathyroid tissue with round cell infiltration and adenomatous areas.

From Hunter's work it would seem probable that a definite type of osteoporosis associated with hyperthyroidism (exophthalmic goiter) and characterized by a low rather than a high blood calcium will have to be recognized.

In the postoperative period, the patient should immediately be administered 20 units of Collip's extract per day; later on calcium products are given by mouth or better intravenously and if there is only one parathyroid left, the patient seems to come into complete equilibrium of parathyroid function within a very few weeks. Most astonishing is the almost immediate cessation of the most severe pain, which must be due to endocrine changes, because as far as the *x*-rays show, the return of calcium in the softened bones takes from three to seven months after the operation,

Fig. 7, Case VII. A. Bowing of back and shortening of stature. B. Flattening of vertebrae. C. Adenomatous parathyroid tissue. D. Adenomatous parathyroid tissue.

but the cessation of pain and the gain of weight start practically immediately.

CONCLUSIONS

1. Parathyroidism seems to be a very frequent affection and will be encountered often if the symptoms are looked for and interpreted properly; at least a lesser degree of the condition seems to be very frequent.

2. General demineralization of the bones, due to deficiency of calcium, in addition to localized cystic areas usually with severe pain in the bones, especially in back and legs, is the rule. The combination of these bone changes with high blood calcium and lowered blood phosphorous, should be sufficient reason to investigate the parathyroid area for tumor or hyperplasia of the parathyroids.

3. The parathyroid tumor or hyperplastic gland should be removed in such patients. This operation seems to be fairly safe under proper after-care with the administration of parathyroid hormone, (Collip's extract) and later on calcium preparations.

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ROENTGENOGRAPHY AS AN AID IN OBSTETRICAL DIAGNOSIS*

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ALTHOUGH roentgenography has been employed to the utmost advantage in medicine and surgery, it has not been sufficiently utilized in the field of obstetrics. Yet roentgenography in obstetrics, as compared with the ordinary methods of physical examination, gives such accurate and definite information that it should be regarded as a necessity in every maternity institution or hospital where obstetrics is practiced.

One reason why it has not been more generally employed may be the knowledge that therapeutic doses of *x*-rays have a deleterious effect on the fetus, frequently resulting in deformities. This objection is no longer valid, since diagnostic roentgenography has been accepted and recognized as a harmless procedure. Most observers now agree that there can be no possible danger to mother or child from the brief exposures required to obtain roentgenograms, provided they are not too often repeated. This has been amply proved by the work of Reinberger and Schreier.[1] According to Garland,[2] who made a careful survey of the literature, no single case of injury to either fetus or mother following the use of *x*-rays for purely diagnostic purposes has ever been reported.

Another reason for the delay in adopting roentgenography as a routine diagnostic procedure is probably the fact that many of the methods that have been proposed have appeared so cumbersome and complicated that obstetricians have regarded them as rather impractical. This obstacle to the use of roentgenography in cases in which it is indicated has been surmounted by the development and simplification of the technique.

Roentgenography has been shown to be especially valuable in obstetrics in the diagnosis of pregnancy in obscure cases, the recognition of twins, the differentiation between pregnancy and tumors, the diagnosis of tubal and ovarian pregnancy, and in revealing the presence of a fetal monster. It has also proved its value in supplying a more accurate method of pelvimetry than any heretofore proposed, in furnishing a method of cephalometry in utero, in giving information as to the presentation and position of the fetus, and in demonstrating the mechanism of labor.

In reviewing the history of pelvic roentgenography it seems that the first results obtained by roentgenograms in obstetrics were not encouraging. In 1897, Levy-Dorn[3] recognized the skull of an eight months' fetus in utero by means of a roentgenogram, and the following year Müllerheim[4] described a similar finding. Other obstetricians, however, after making exposures lasting one and one-half hours, reported failure to secure any definite results. In 1908, Bouchacourt[5] came to the conclusion that it was impossible to secure a roentgenogram of a living fetus, or that if a shadow was secured, it was a sign of fetal death.

Albers-Schönberg,[6] in 1904, so improved the technique in roentgenography that its use became more popular in obstetrics. Later Bartholomew,[7] Sheuton,[8] Horner,[9] and Candy[10] showed that the diagnosis of pregnancy could be definitely made after the fifth month.

DIAGNOSIS OF PREGNANCY BY ROENTGEN RAYS

Ordinarily the diagnosis of pregnancy can be made earlier by clinical methods than by roentgenography. In cases of fibroids and other conditions simulating

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pregnancy, however, *x*-ray study may help in differential diagnosis.

This is illustrated by the case of H. C., aged forty, who complained of amenorrhea and increasing size of the abdomen. She had one child, fifteen years old. She had been operated upon one year previously. Three months before the operation, she had had a therapeutic abortion induced because of a large fibroma. After the abortion, she had a fever and had to be removed to the hospital. A month later a laparotomy was done. She was under the impression, which later proved erroneous, that she had a hysterectomy done for a fibroid uterus and a large dermoid cyst. After the operation, she had some scanty bleeding every month. During the last six months, the monthly bleeding ceased and she noticed that her abdomen was growing larger. A diagnosis of ovarian cyst was made by her physician. It was impossible to obtain a correct report of the nature of the operation.

The physical examination was unsatisfactory: The abdomen was very tense and tender, no fetal parts were felt, no fetal heart sound could be elicited, and no fetal movements were observed. There was only a suspicion of the presence of internal ballottement.

Fig. 1. Flat roentgenogram, taken with patient lying on her abdomen, showing six and one-half months' pregnancy with left breech presentation.

Fig. 2. Four and a half months' pregnancy. In this case, clinical examination could not establish the diagnosis of pregnancy and only the roentgenogram saved the patient from a hysterectomy on the supposition that the condition was one of fibroids. (Slightly retouched.)

A flat roentgenogram with the patient lying on the abdomen (see Fig. 1) showed a six and one-half months' pregnancy with a right breech presentation.

In another case (see Fig. 2) the history and physical examination strongly suggested a condition of uterine fibroids. The roentgenogram revealed a four and a half months' pregnancy and thus saved the patient from an unnecessary hysterectomy.

Figure 3 illustrates a similar case in a five months' pregnancy.

The diagnosis of pregnancy can be made by recognizing the fetal bones roentgenographically as early as the fourteenth week. With proper preparation and careful technique, it is often possible to demonstrate the fetus during the third month.

Leiser,[11] of Warnekros' clinic at Dresden, reports the use of the *x*-ray for the early diagnosis of pregnancy in 61 cases. The Potter-Bucky diaphragm was used with a current of 100 ma. and an exposure of two and one-half seconds. A ventrodorsal

exposure was usually employed and occasionally a dorsoventral exposure as well. In a few instances the latter demonstrated the presence of a fetus when the former gave negative results.

Of the 61 cases studied, there were 41 in which the presence of a fetus was clearly demonstrated; and in 1 of these cases, the diagnosis of pregnancy, as against that of an intra-uterine tumor, was established. In 20 cases no fetus was demonstrated; in 2 cases a diagnosis of myoma was made and proved correct at operation; in 4 cases a subsequent curettage showed only placental tissue. In 14 cases pregnancy was not demonstrated although diagnosed clinically. In all of these cases examination was made in the eighth to twelfth week of pregnancy. In the 41 cases in which a definite roentgenological diagnosis was made, the pregnancy was in the fourteenth to twentieth week.

It was not possible, therefore, to make a diagnosis of pregnancy prior to the fourteenth week; but the method did not fail after that time. Obesity or the coexistence of a tumor does not prevent the correct diagnosis of pregnancy after the fourteenth week. At this period all the fetal bones are not necessarily shown in the roentgenogram. Sometimes only a few vertebrae, ribs, or bones of the extremities are visible; the fetal head is less frequently shown than the vertebral column. The position of the fetus in utero can, however, be determined.

Jungmann's[12] method for the demonstration of early pregnancy includes the use of the Potter-Bucky diaphragm. As a rule, the rays are directed axially through the pelvis from in front and above downward and backward, as for an axial roentgenogram of the bladder. In this way, the maternal bones are not shown except for a small portion of the lower part of the sacral bone and the coccyx. In some cases, the patient is put in the oblique half-dorsal position and the rays are directed from an antero-inferior position on the left side backward and upward to the right side. This method is used when the uterus is high.

In early pregnancy, only some of the fetal bones are demonstrable. The vertebrae and ribs are most frequently shown, their arrangement and appearance depending upon the position of the patient and the direction of the rays. With his method Jungmann has found it possible to demonstrate pregnancy in the eighth to the ninth week in some cases. From the tenth week on he has been able to demonstrate pregnancy as a rule, except under especially difficult circumstances.

Fig. 3. Five months' pregnancy. In this case, clinical examination could not establish the diagnosis of pregnancy and only the roentgenogram saved the patient from a hysterectomy on the supposition that the condition was one of fibroids. (Slightly retouched.)

For the diagnosis of early pregnancy by *x*-ray, Dujol and Michelon[13] use a 40 ma. current, the Potter-Bucky diaphragm, and an exposure of two to four seconds. The patient is placed in the dorsal decubitus and the tube inclined at 35° as for roentgenography of the bladder, in such a way as to enlarge the image of the pelvis and thus facilitate demonstration of the presence of the fetal bones.

In 34 cases studied in pregnancies of twenty-two weeks or less, there were 11 cases in which no fetal skeleton was demonstrated. In no instance was it demonstrated

before the fourteenth week, but in one case a clear image of the fetal skeleton was obtained in the fourteenth week, an unusual and remarkable picture. In the fifteenth week, 2 cases were examined, both positive; in the sixteenth week, of 3 examinations 1 showed the fetal skeleton clearly and 2 rather indefinite shadows suggesting a vertebral column in one instance and a head shadow in the other.

FIG. 4. Twin pregnancy. Only the roentgenogram disclosed the true condition. (Slightly retouched.)

In this group of cases studied by Dujol and Michelon, a definite diagnosis of pregnancy as against tumor was made by demonstration of the fetal skeleton. In 3 cases the presence of a dead fetus was demonstrated.

Bouchacourt[5] is of the opinion that roentgenographical diagnosis of pregnancy cannot be made before the third to the fourth month. Then the fetal skeleton is always demonstrable, but in normal cases roentgenography is not necessary for the diagnosis of pregnancy at that time. It is of value in the later months of pregnancy, however, in determining the position of the fetus; in the diagnosis of twin pregnancy and fetal malformations, such as hydrocephalus; and for the diagnosis of the death of the fetus in utero. It is also of value for the diagnosis of tumors complicating pregnancy, and for measurement of the size of the fetal head in relation to the pelvis.

For roentgenological study of the pregnant uterus, Bouchacourt[5] uses, as a rule, the Potter-Bucky diaphragm with the patient in ventral decubitus. Lateral views are also of definite value in the late stages of pregnancy, as they avoid the superposition of the maternal on the fetal skeleton.

Jaubert de Beaujeu[14] has not employed the Potter-Bucky diaphragm for the early diagnosis of pregnancy, but has directed the rays very obliquely with a short focal distance with instantaneous exposure. The patient is in ventral decubitus and the film with two intensifying screens covers the subpubic rectangle. The rays are directed obliquely from behind forward in the line of the neck of the femur and from above downward so as to pass in front of the coccyx. Lateral exposures may also be made. The images obtained are deformed and enlarged, but sufficient to demonstrate the presence of the fetal bones. This method avoids a superposition of the maternal bones on those of the fetus. By this method it was found possible to demonstrate the fetal bones from the third to the fourth month. The earliest pregnancy in which this was done was three months and ten days.

DIAGNOSIS OF TWIN PREGNANCY

The diagnosis of multiple pregnancy during the earlier months often presents difficulties. In such cases roentgenological study clears up all doubt.

Figure 4 shows a twin pregnancy at term. In this case two fetal hearts could not be heard, nor was there a multiplicity of fetal parts detectable on palpation. Only the roentgenogram disclosed the true condition.

Figure 5 is the roentgenogram of a woman, seven and a half months pregnant, over whose abdomen fetal heart sounds were heard in several areas. The possibility of twin pregnancy was therefore suspected. However, the film showed only one fetus, in the left occipito-transverse position. In this case it was impossible to locate the presenting part by physical examination.

Fig. 5. Normal pregnancy at seven and a half months. On physical examination, it was impossible to make out the presenting part. As fetal heart sounds were heard in several areas, the possibility of twins was suspected. The film shows one fetus only, in the left occipito-transverse position.

The lateral view is of particular value in the recognition of twin pregnancy (Grier).[15] The procedure, however, may be difficult. The abdomen is usually large and the quantity of amniotic fluid great. In early pregnancy, it may be impossible to demonstrate the fetal bones in the anterior view, but they may be seen in the lateral view.

I have observed several cases in which only the roentgenogram disclosed the existence of twins. In other cases, where there appeared to be a multiplicity of fetal parts and fetal heart sounds were heard in several distant areas, it was the roentgenogram which proved that only one fetus was present.

Fig. 6. Right occipito-posterior presentation, eight months' gestation.

DIAGNOSIS OF POSITION AND PRESENTATION OF FETUS

X-ray films after the sixth month clearly show the presentation, position and posture of the fetus.

In Figure 6 a right occipito-posterior presentation in an eight months' gestation is clearly revealed. Figure 7 shows a left occipito-transverse position with marked overriding in a patient who was in labor twenty-four hours and overdue.

Face presentation at term is clearly shown in Figures 8 and 9.

Nölle[16] has found the *x*-rays of definite value in determining the position of the fetus and in the diagnosis of twin pregnancy and of fetal malformations, especially in the presence of hydramnios. In 2 cases he was able by this means to diagnose an anencephalus prior to labor. An irregular bony formation was shown above the cervical vertebrae corresponding to

the base of the skull; the vault of the skull was entirely absent.

Blanche[17] (1927) states that he has demonstrated the fetal bones in utero as early as three months and a half in pregnancy and in 1 case in which the pregnancy was only a few days over the third month, but in another recent series of examinations he was not able to obtain definitely positive roentgenographical evidence of pregnancy until toward the end of the fourth month. In those cases in which the fetal bones were demonstrated in the roentgenogram before the fifth month of pregnancy, the cervico-dorsal portion of the vertebral column was most frequently visible and also the points of ossification of the head, especially the occipital; much more rarely the ribs and only exceptionally one of the long bones could be seen. The presence of the fetal skeleton can be demonstrated about three weeks before there are clinical signs of fetal life.

Fig. 7. Left occipito-transverse position with marked overriding; patient twenty-four hours in labor and overdue.

In the later months of pregnancy, with good technique the fetal skeleton is usually shown in its entirety. This makes it possible to determine the position of the fetus in utero before labor and the exact position of the head in relation to the superior strait.

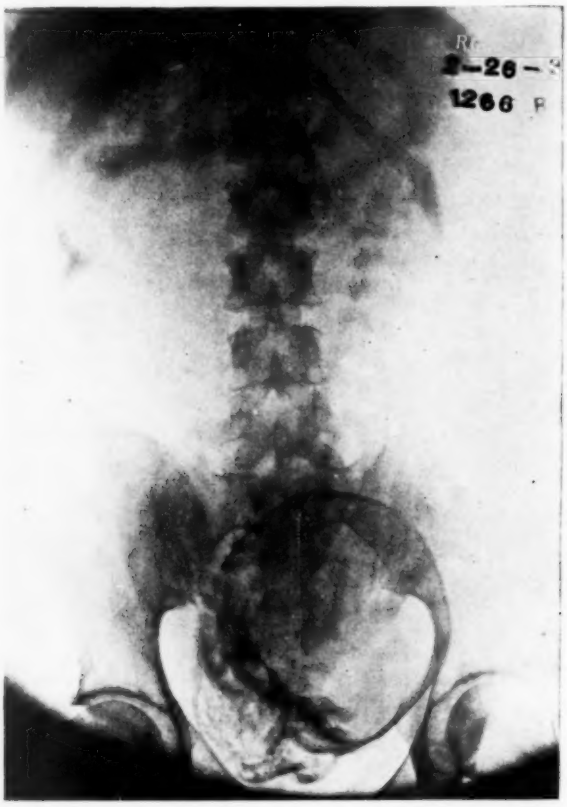

Fig. 8. Left mento-posterior position at term. Patient in labor three days; ruptured membranes; marked Bandl's ring; cesarean section done with peritoneal exclusion. Anterior view.

Roentgenography in the later months of pregnancy also shows the presence of twins, of fetal anomalies, and of fetal death; it makes it possible to differentiate a tumor from pregnancy and also as a rule to diagnose the presence of a tumor complicating pregnancy. Blanche[17] has not found roentgenography of value in the diagnosis of extra-uterine pregnancy, unless it has become encysted or calcified (lithopedion).

In the roentgenography of the pregnant uterus, he has found the best technique to include the use of a 60 to 80 ma. current with hard rays (70 to 80 kv.) and the

Potter-Bucky diaphragm, with exposure of one second. The patient is in the ventral position, as a rule, but lateral views are

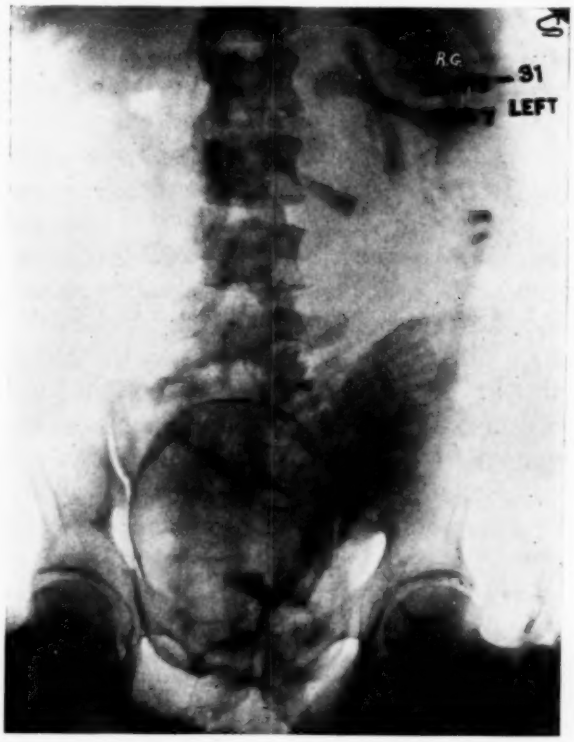

Fig. 9. Same as Fig. 8, posterior view.

taken in some cases. In early pregnancy the *x*-rays should be centered on the axis of the pelvic cavity.

DIAGNOSIS OF ABNORMALITIES OF THE FETUS IN UTERO

The recognition of monstrosities is greatly aided by *x*-ray examination (Grier[15]). This subject has been covered in great detail in a monograph by Dorland and Hubeny.[18] Both anteroposterior and lateral views are indispensable for this purpose.

Anencephaly has been recognized from the anteroposterior view, but for the detection of abnormal development of other parts of the skeleton the lateral view is more valuable. Absence of the vertebrae and bones of the pelvis, decrease in the number of ribs, and abnormal development of the bones of the skull have been recognized in utero in the lateral view.

Albano[19] reports a case in which a diagnosis of hydrocephalus with the fetus in breech presentation was made in the

Fig. 10. Left transverse presentation, two weeks before term. Patient in labor for two hours. Strong pains, tearing in character, at frequent intervals. Membranes not ruptured. Roentgenogram shows fetus lying high above crests of ilium. Under deep anesthesia external cephalic version performed. Head held on brim of pelvis for nearly an hour. Pains practically ceased. Pituitin 0.2 c.c. given to strengthen pains and facilitate engagement. Patient delivered spontaneously of 6½ pound living baby.

early stage of labor where the correct diagnosis could not have been established clinically. Craniotomy was found to be necessary for the extraction of the fetus. The puerperium was normal. A mistaken diagnosis in this case would have endangered the mother's life. This case illustrates the great value of roentgenological diagnosis in cases of fetal abnormalities at or near term.

Roentgenology is also valuable in the differential diagnosis of obscure abdominal masses and pregnancy. Hydramnios is so commonly associated with monstrosities that a routine roentgenogram is necessary. Early recognition of these deformities

would prevent the continuation of such a pregnancy, a prolonged labor, or even cesarian section.

Hauch[20] has not found the *x*-rays of special value in the early diagnosis of pregnancy, as the diagnosis may be made equally early by other methods. But he has found it of definite value in differentiating between a pregnancy and a tumor; for the diagnosis of late extrauterine pregnancy; for demonstrating the presence of a dead fetus; for the diagnosis of twin pregnancy; and finally for the diagnosis of fetal malformations and monstrosities before or at the time of labor.

Favreau[21] states that in some cases the fetal skeleton is demonstrable in the roentgenogram before the fetal heart sounds can be heard. In 1 case at least, it was demonstrated before the fourth month. As a rule, however, he has found that the fetal skeleton cannot be demonstrated with certainty before the fourth month. In some cases a very careful examination of the roentgenogram must be made before evidence of the fetal skeleton is found. As a rule, in a five months' pregnancy, the vertebral column, slightly curved, and the base of the skull are visible, and in some cases the bones of the extremities.

The death of the fetus in utero is indicated by overlapping of the cranial bones and the disappearance of the cerebral contents. In case of maceration, the skeleton appears smaller than normal for the duration of the pregnancy and the outlines of the bones are somewhat obliterated.

Case[22] (1917) reported the first instance of roentgen diagnosis of anencephalus, before birth, and in 1926, he reported 3 additional cases. Other authors have reported 11 cases, making a total of 15. Roentgenological examination in anencephalus shows an absence of the fetal cranial vault, small orbits, absence of sella turcica, and a tendency to cervical spina bifida.

Two cases of anencephaly diagnosed by roentgenology are reported by Beath.[23] The first patient, a primipara thirty-nine years of age, appeared to be in about the eighth month of her pregnancy. The roentgenogram showed a normally developed fetus as regards trunk and limbs, but no cranial shadow. Induction was decided upon and an anencephalic child weighing 5 lb. removed. The mother recovered. The second case was that of a primipara at full term. The roentgenogram showed fetal shadows of the thorax and limbs, but no cranial shadow. Before any measures could be taken the patient entered into labor, which lasted two days. Delivery was difficult and the mother died from shock. Beath thinks these 2 cases prove quite definitely the value of early roentgenology in doubtful abnormalities of pregnancy.

There is a syndrome which is strongly suggestive of deformed fetuses in utero (Falls[24]). Roentgenograms will clearly demonstrate the deformity in anencephalic, hydrocephalic or spina bifida fetuses as early as the sixth month; but a negative *x*-ray does not exclude the possibility of deformity. The syndrome is as follows:

1. Hydramnios occurring about the seventh month, associated with uterine tension and easy ballottement.
2. Inability definitely to outline the fetal head suggests anencephaly, while abnormal size or consistency suggests hydrocephalus.
3. Anencephaly is suggested by difficulty in differentiating between the fetal parts either by abdominal or vaginal palpation. Also a soft meningocele surrounded by a bony ring may be felt on vaginal examination with a finger inside the cervix in cephalic presentations.
4. Fetal heart tones heard faintly or absent when hydramnios is marked.
5. Abnormally active fetal movements, which may become convulsive if pressure is made on the head in cases of anencephalic monsters.

OVARIAN PREGNANCY

Ovarian pregnancy has been diagnosed by skiagrams (Candy[25]). The appearance

was that of normal pregnancy of about eight and one-half months, but the patient complained of great discomfort and distention. Palpation and vaginal examination under anesthesia failed to reveal the presenting part. *X*-ray examination showed a fully developed fetus, the position and attitude of which were extremely irregular. The head and cervical spine were acutely flexed upon the chest, the cervical spine forming an acute projection against the anterior abdominal wall of the mother. The head was outside the pelvis and could not be made to engage. The lateral view showed the fetus to lie in a much more ventral position than normal. Cesarean section was performed and a fulltime ovarian pregnancy revealed. The uterus was in the pelvis and was slightly enlarged. The right fallopian tube was flattened and stretched over the gestation sac. The tissue of the right ovary was thinned out and constituted the outer layer of the sac, which lay above the broad ligament. The child appeared to have been dead for two or three weeks.

Tubal pregnancy is apt to rupture before reaching a size permitting of its roentgenological recognition other than by the special method of uterosalpingography.

THE MECHANISM OF LABOR AS STUDIED BY X-RAYS

The older texts on obstetrics taught that, at the onset of labor, the fetus is forced towards the path of least resistance, i.e., the lower uterine segment and the cervical canal. In the mechanism of labor the passages are the determining factors. The different diameters of the pelvic planes and the varied measurements of the manifold circumferences of the fetal-presenting part necessitate the rotation, flexion, etc., of the fetus, in order that it may pass through the birth canal.

Recent studies have somewhat modified this teaching. The anterior rotation of the child is governed by the law of accommodation of elastic resistance to the shape of the container. The birth canal is shaped like a straight tube with a sharp upward curve at its lower end; the fetus, like two ovoids, head and trunk, united by a hinge, the cervical vertebrae. The birth canal would, therefore, force such a bicorporate hinged object to bend in the same direction, i.e., the lower ovoid, or presenting part, would be forced upward or anteriorly. The fetus, due to uniform internal pressure, assumes a cylindrical contour, with a maximum bending facility in certain directions only: the head backwards and the body in a diametrically opposite plane. In order, therefore, for the fetus to pass the lower upward curve of the birth canal, it must proceed with a spiral-like motion so that it approaches the curved portion of the canal with that part of the fetal ovoid possessing the greatest bending facility in that direction.

Warnekros[26] was able to obtain roentgenograms of the fetus in all stages of labor; and he has shown definitely that, when the head of the fetus enters the pelvis, the occiput and sinciput are on the same level, in a position between flexion and extension. In the first stage of labor, the uterine contractions cause the fetus to assume a more pronounced attitude of flexion, which is, however, only transitory; between pains, the child assumes a more natural and comfortable attitude of semiflexion. A reactive influence upon the fetus sets in with the rupture of the membranes, causing it to stretch out, so that the fundus uteri can be observed rising towards the ensiform process.

The spinal column is so constructed that each division tends to bend in the opposite direction of the other so that orthostatic posture is maintained. The force of the fetal axis pressure directed to the upper pole will cause the entire column to assume a form which will transmit this pressure to the lower pole. The dorsal vertebrae assume a kyphotic curve and the cervical vertebrae a compensatory lordotic curve. When the force of the uterine contraction is transmitted to the head, attached to the vertebral column at its condyles, the

sinciput is flexed and the occiput descends and is rotated anteriorly.

It has been further shown by Warnekros that the fetus is not an ovoid cylinder with bony protections consisting of the bones of the upper and lower extremities. The fetal extremities do not assume a regular attitude, but are thrown about in the uterus. The back of the fetus rotates anteriorly before the head rotates, and when the head is at the orifice, with the occiput pointing directly anteriorly, the shoulders are then entering the pelvis transversely. The chest of the fetus appears compressed while making its exit from the pelvic outlet.

Clinical *x*-ray studies concerning the mechanism of labor help to explain how puerperal fever may develop in the absence of infection introduced from without. They prove that the presenting part acts like a bacteria-smearing swab, whereby the damaged tissues with which it comes in contact may readily be inoculated by microorganisms already present in the vagina.

SUMMARY

Roentgenography has proved its value in obstetrics principally for the following diagnostic purposes:

1. For the positive diagnosis of pregnancy in obscure cases. This can be accomplished by the fourteenth week, sometimes earlier. In some of the author's cases, the clinical findings strongly suggested uterine fibromyomata and only the roentgenogram saved the patient from an unnecessary hysterectomy.

2. For the recognition of twins. Particularly in obese patients, there may be difficulty in hearing two separate fetal hearts or palpating a multiplicity of fetal parts; vice versa, the same fetal heart may sometimes be heard clearly in widely separated locations, leading to an erroneous diagnosis of twin pregnancy. In such cases, roentgenography gives a definite answer.

3. For differentiation between pregnancy and tumors. Here roentgenography supplements findings by the Aschheim-Zondek test.

4. For diagnosis of tubal and ovarian pregnancy.

5. For revealing the presence of a fetal monster. The recognition of anencephalus and other forms of fetal monstrosity is greatly facilitated by *x*-ray study.

6. For giving information as to the presentation and position of the fetus. As shown by several of the author's films, the exact presentation and position are revealed with far greater accuracy than can be determined by physical examination alone. This also obviates the need of a pelvic examination.

7. For demonstrating the mechanism of labor.

8. For supplying a more accurate method of pelvimetry than any heretofore proposed and furnishing a means of cephalometry in utero. This subject will be discussed in a subsequent paper appearing in a future issue of The American Journal of Surgery.

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[For remainder of References see p. 442.]

PYELOGRAPHY WITH EMULSIFIED CAMPIODOL*

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FOR the past eight years I have been trying various solutions for pyelography. I first used sodium bromide, but found that it was not sufficiently opaque in less than 25 per cent strength, when it is somewhat irritating. Neosilvol, also, must be from 20 to 30 per cent, but it is relatively non-irritating and quite satisfactory. Sodium iodide, 12.5 per cent, is a satisfactory solution except that in about one-half of the patients it causes considerable pain for a few hours after its use. Furthermore, its presence in an inflamed pelvis causes pain, so that in my experience it is difficult to tell when the pelvis is full, and unsatisfactory pyelograms often result. Lipiodol diluted with olive oil is non-irritating and makes good ureterograms. Since it is not miscible with urine, the finer details of the calyces are not shown. In addition, the viscoscity of lipiodol is so great that injection through a ureteral catheter is difficult.

Campiodol is a stable, non-toxic, iodized rape seed oil containing 43 per cent iodine. For pyelographic purposes it is emulsified with equal parts of acacia solution, and is marketed in ampoules containing 10 c.c. of the emulsion. I agree with Glaser and Kutzman,[1,2] who first used it in pyelography, that it is remarkably free from irritating properties.

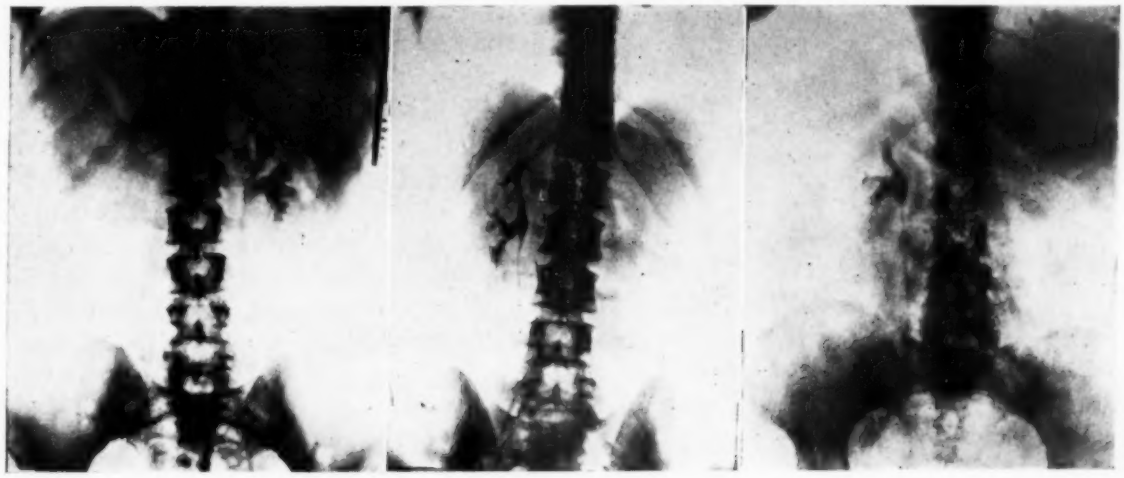

FIG. 1. FIG. 2. FIG. 3.

FIGS. 1, 2, 3. Pyelogram in chronic pyelitis.

The warmed emulsion can be injected easily through a No. 6 French catheter, and the patient has no discomfort until the pelvis is full. The injection should be stopped when the patient reports a feeling of fullness in the kidney region. There is no after-pain unless the pelvis has been overdistended.

Pyelograms made with emulsified campiodol are as clear as those obtained with 12.5 per cent sodium iodide, and ureterograms are better, as the increased viscosity delays the emptying time of the ureter. Accompanying illustrations demonstrate its value.

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WHOLE BLOOD TRANSFUSION*

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TRANSFUSION of whole blood is conceded to be far more beneficial to the patient than the transfusion of blood which has been chemically or mechanically altered to prevent coagulation.

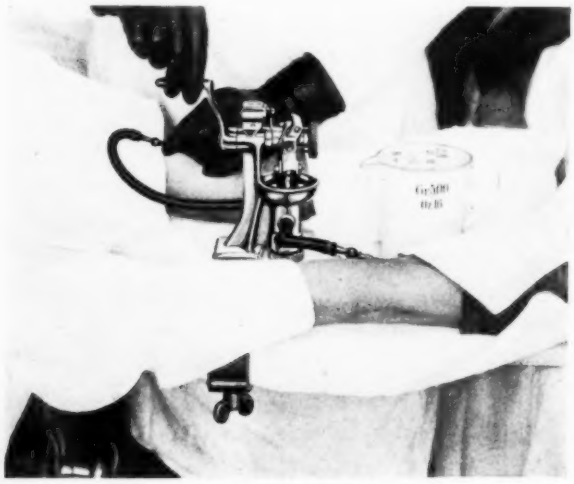

FIG. 1. Head transfusion pump in use. The donor's needle is held in proper position to prevent invagination of the vein wall into the tip of the needle by the strong pump suction.

The exacting technique of the earlier methods of whole blood transfusion presented so many difficulties that these methods have not become popular, while the citrate method has been widely adopted because of its simplicity of performance.

While the Kimpton-Brown paraffin lined tube causes the least mechanical damage to the blood of the several whole blood methods which allow measurement of the amount of blood transfused, it is necessary with this method to dissect out both the donor's and recipient's veins. This is, of course, an objectionable feature of the method. The Vincent and Moore tubes, with their large needles, obviate dissection of the veins in most cases, and are thus the most practical of the paraffin tube methods. A skillful technician can use these methods to excellent advantage but their rapid and exacting technique precludes their use by those who transfuse only occasionally instead of frequently.

The multiple syringe method of Lindeman and the syringe and valve methods of Unger, Soresi and others have been widely used by operators who prefer whole blood transfusions, but the simplest and most durable of all the transfusion pumps, which was designed by J. R. Head has not received the recognition it deserves. The elimination of valves, springs, and small orifices through which blood must be forced under pressure, contributes to the ease of operation and obviates fibrin formation and sticking. All metal construction renders it unbreakable and the cost of operation and upkeep is nil.

TECHNIQUE

1. A healthy, Wassermann-negative donor of the same blood group as the patient, who has been properly cross-matched before transfusion, is used.

2. The pump, together with needles, a sharpening stone, rubber tubing, glass adaptors, a porcelain cup, an ampule of novocaine and a hyposyringe, gauze sponges, towels, gloves and gown are wrapped on a tray, autoclaved and the sterile pack kept ready for use at any time.

3. An armboard, 30 by 14 in., is placed under the donor's shoulders and comfortably padded. The donor's arm, with a sphygmomanometer bag for a tourniquet, is cleansed and laid on a sterile towel across the side of the armboard nearest the operator.

4. The pump is fastened to the armboard and the patient's arm is laid on the opposite side of the pump. Both arms are then covered with sterile towels, exposing the puncture sites only.

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5. The needles are "touched up" on the oil stone, if necessary, and attached to the pump by means of glass adaptors and heavy rubber tubing. The system is then filled with saline and the donor's needle left in the saline cup.

6. The recipient's veins are distended by tourniquet pressure and puncture is made with the attached needle through an intradermal novocaine wheal. Blood appears in the glass adaptor when the vein is entered. The needle is inserted well into the vein and tourniquet pressure released. A sufficient amount of saline is then pumped from the cup into the recipient's vein to assure the operator that his needle is properly placed.

7. The donor's vein is then punctured, the counter reading noted and the transfusion completed by pumping the required number of turns at the rate of about 100 turns a minute. The glass adaptors are convenient as venepuncture can be done without loss of blood or soiling of linen as when puncture is done with a detached needle.

8. The donor's needle is withdrawn first, dropped into the saline cup and pumping continued, washing the remaining blood into the patient's vein.

9. The entire procedure can be completed in seven to ten minutes with no loss of blood.

CONCLUSION

Personal experience with each of the transfusion methods mentioned, leads me to believe that the Head transfusion pump provides a very simple and safe method of whole blood transfusion which may be performed by anyone capable of accurate venepuncture.

In series of 200 transfusions with this pump, reaction has not occurred when a properly cross-matched donor was used.

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MASSIVE PULMONARY COLLAPSE

COMPLICATING PNEUMONIA*

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MASSIVE pulmonary collapse of the lung is a definite clinical entity and is a condition in which one or more lobes, previously well aerated, lose their air and collapse. In this collapsed state the lung occupies a smaller space than it did when fully expanded and becomes denser in character.

Pulmonary collapse or pulmonary atelectasis, whether it be postoperative or the result of a complication of other diseases, is to our mind the same as regards the etiological factor.

The literature contains abundant material of the postoperative type, but in reality the etiology is the same as was found in our cases following the onset of pneumonia.

Attention was first called to this condition by Pasteur in 1890, although an identical case was reported by Pearson Irvine in 1876. Later, J. Rose Bradford wrote on this topic, while recently great strides have been made by such geniuses as Jackson, Lee, Tucker, Clerf, Hearn, Mastics, Davidson, Harrington, Sante and others. We believe this condition exists more frequently than is thought. Many cases are mistaken for pneumonia for the signs and symptoms are identical in a great proportion of cases; when this happens the patient expires as an unrecognized case or the diagnosis is verified at autopsy.

Types: Several authors have classified massive collapse into clinical types:

Mastics:

a. Fulminant or massive type.
b. Moderate type.
c. Late or mild type.
d. Transient type.

Lee and Tucker suggest two groups:

a. Massive.
b. Partial.

These authors also use a strictly anatomic classification:

a. Massive.
b. Lobar.
c. Lobular.

We believe that the latter classification is more consistent with the generally excepted nomenclature.

Etiology: There are still a number of causes suggested but no general acceptance of any of them. The one most accepted is the explanation of Elliott and Dingley that it results from diaphragmatic immobilization associated with bronchial obstruction, the alveolar air being absorbed by the circulating blood. Jackson, Lee and Tucker, in support of this theory, have removed masses of bronchial secretions obstructing the bronchus in 3 cases, Lee and Clerf in 2 cases, and Hearn and Clerf in 1 case. This theory is also supported at this clinic, as the author reports 2 similar cases. The tenacious secretion completely occludes the bronchi proximal to the collapsed tissue and upon aspiration the affected lung reinflates with air. On collecting this tough, tenacious material in a Luken's specimen tube, it is so thick and stringy that in a few minutes it becomes jelly-like in consistency. We feel that blocking of a bronchus with this thick secretion is a definite etiological factor in collapse. Everyone will admit that a lung cannot expand when the bronchus is completely blocked.

The mechanism by which the obstruction is produced was suggested by Archibald. Following the effort of coughing there is a more or less complete evacuation of the bronchial contents, but immediately following the expiratory effort of coughing there is a great, if not greater, inspiratory effort when probably as large

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or a larger volume of air is drawn into the alveoli. The question was raised by Archibald whether, if the bronchial secretions were not entirely expelled by the respiratory effort, they would be drawn further into the bronchial tree by the inspiratory rush of air.

Fig. 1. Roentgenogram (taken by Dr. W. E. Reiley) three days after onset of pneumonia and one hour after symptoms of collapse appeared. Collapse of entire right lung.

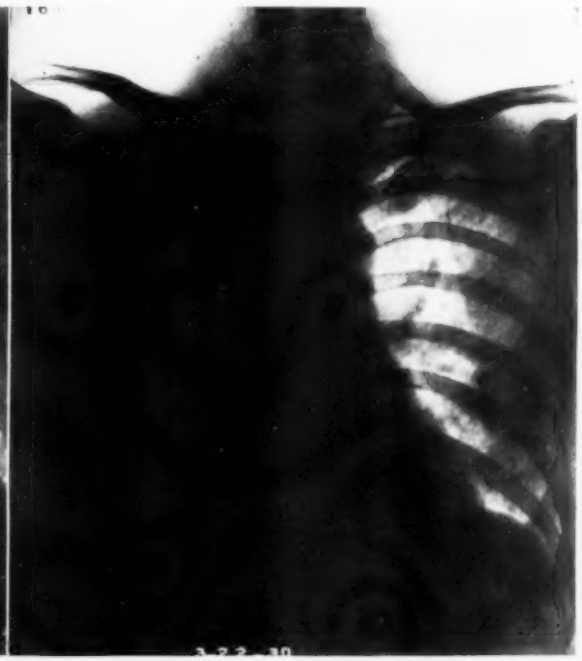

Fig. 2. Roentgenogram by Dr. W. E. Reiley taken twenty-four hours after first bronchoscopic aspiration and twelve hours after appearance of collapse the second time. Collapse of entire right lung.

Signs and Symptoms: The symptoms vary according to the part and amount of involvement. The patient may complain for hours before clinical symptoms appear in reality. A rise in temperature, increase in pulse rate and respirations constitute the starting point, followed by a cough with very little or no expectoration, pain in the chest, cyanosis and dyspnea. Inspection reveals immobility of the affected side and as a rule displacement of the apex beat toward the involved side, but this was not verified in one of our cases, for the beat was not displaced. The intercostal spaces are narrowed, the ribs seem to converge; dullness or flatness is present over the affected area while above hyperresonance and even tympany may be found. Pectoriloquy is often marked. The diaphragm of the affected side is elevated while the opposite side is lower than its normal position.

Treatment: Bronchoscopic investigation should be carried out early after the diagnosis of collapse is made if the surgeon and internist deem it a capable procedure in the particular case. A skilled bronchoscopist can carry out the regular procedure with very little discomfort to the patient. General anesthesia is contraindicated. For adults morphine may be given for the cough, while in children over twelve years of age, cocaine may be applied locally to abolish the cough reflex.

Case 1. C. McM., a male aged thirty, was admitted to the medical department of the Clearfield Hospital, complaining of pain in the chest, fever and difficult breathing. The history was that three days before he had had a severe chill which was followed by a rise in temperature associated with sweating. These symptoms continued to become markedly worse. He therefore applied for admission to the hospital.

On admission the temperature was 103°F.

pulse 120, respirations 30. The blood hemoglobin was 70 per cent, the erythrocytes numbered 3,380,000, leucocytes 5800, the polymorphonuclears 52 per cent, small lymphocytes 40, large lymphocytes 7, transitionals 1; urea-nitrogen 45.36 mg., creatinine 2.5 mg., sugar 80 mg. The Kahn test was negative. The renal efficiency test showed a total of 5 per cent.

Physical examination revealed the following: *Head*—scalp normal, eyes negative: mouth—tongue dry and coated, throat injected. *Chest*—expansion limited on the right side; impairment over the upper lobe of the right lung, many râles; pulse rapid, heart sounds weak, slight functional systolic murmur present. A diagnosis of lobar pneumonia was made by the medical chief, Dr. G. B. Yeaney, after which the patient was placed on the routine treatment. The two days following his admission he gradually grew weaker, the temperature rose while the pulse became rapid and weak. The patient became restless and dyspneic. There was marked limitation of movement of the right chest. There was a hyperresonant note over the entire left lung area. The percussion note over the right lung was dull. The respiratory rate was 48.

Dr. S. J. Waterworth saw the patient in consultation at this time, following which a diagnosis of possible collapse of the entire right lung was made. Roentgen examination was made with the following report: "The entire right chest is opaque, the ribs can be seen, opacity faintly, as also the right border of the heart. There may be a thickened pleura with a small amount of fluid. Since the left lung is not involved it is most probably not malignant."

After the consultation the patient was referred to the bronchoscopic department and three hours later bronchoscopy was performed with this report: "Mucous membrane of the posterior pharynx injected, the epiglottis flaccid and lying over the laryngeal opening. The mucous membrane of the larynx and ventricular bands very red. The glottic chink and vocal cords were normal. The mucous membrane of the trachea and right bronchus was of a deep red color." When the tip of the bronchoscope was passed into the right bronchus about 3 cm. below the carina it met an obstruction which had the appearance of a gelatinous material. The aspirating tube was passed through the bronchoscope to the obstructing area and after careful manipulation the tip of

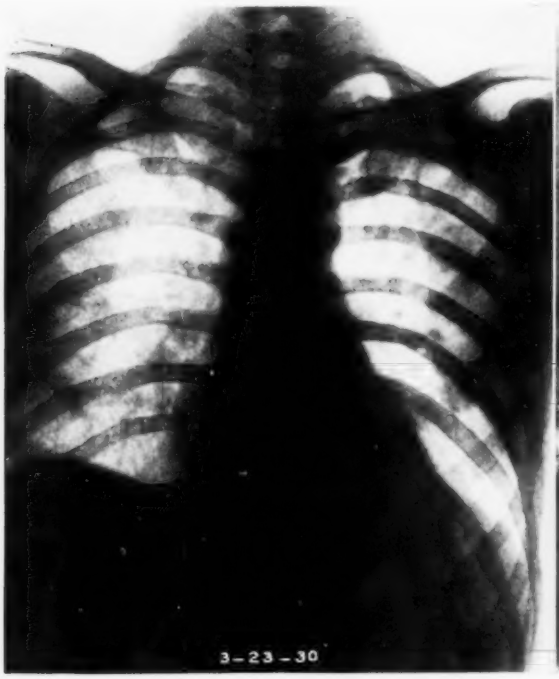

Fig. 3. C. McM. Roentgenogram by Dr. W. E. Reiley taken twelve hours after second bronchoscopic aspiration. Right lung almost clear except for mottling as appears in resolving pneumonia.

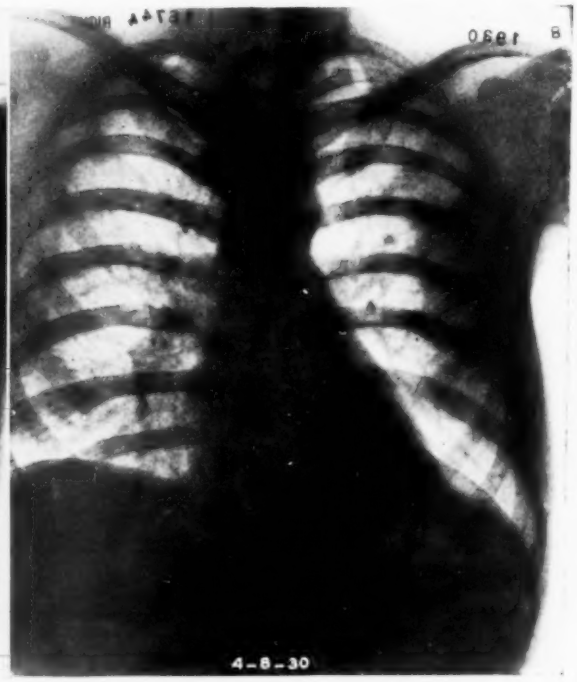

Fig. 4. C. McM. Roentgenogram by Dr. W. E. Reiley taken nineteen days after first bronchoscopic aspiration. Right lung shows some mottling with great improvement since last examination.

the aspirating tube was teased through what seemed to be gelatinous material. After the tip passed 4.5 cm. through this substance aspiration took place with the result that a thick tenacious secretion in which was found small particles which in appearance resembled necrotic lung tissue. This material was aspirated into a Luken's specimen collector. The aspirating tube was then brought out and about 5 cm. above the tip there was a thick plug of gelatinous material adherent. Another aspirating tube was placed into the right bronchus until complete removal of the material which amounted to 18 c.c. was accomplished.

Instantly after the aspiration the dyspnea disappeared and movement of the right chest with respiration was noted. The patient stated that he could breath without difficulty. A few minutes later faint breath sounds could be heard over the right lung area. The laboratory report from this specimen was as follows: "Thick mucopurulent material; pneumococci, few streptococci and staphylococci." That evening the temperature dropped from 103.2°F. to 98.4°F. with an associated decrease in the pulse and respiratory rate. The following morning the temperature rose to 103°F. with an increase in pulse and respiratory rates. The symptoms of restlessness and dyspnea again became marked. Roentgen examination gave the same appearance as on the preceding day. Here again it was decided to perform bronchoscopic aspiration, at which time 12 c.c. of thick purulent secretion were withdrawn by aspiration. The temperature dropped to normal as did the pulse and respiratory rates. Roentgen examination twelve hours after second bronchoscopic aspiration showed that the right lung was almost clear; there was considerable mottling, such as appears in a resolving pneumonia. Thirty-six hours after the second aspiration considerable bubbling was noted, similar to that noted in pulmonary edema. Although the temperature, pulse and respiratory rates were normal a third bronchoscopy was performed. At this aspiration 6 c.c. of a dirty, mucoid substance were removed. The patient made a splendid recovery and was discharged twenty-six days after the first bronchoscopy. Roentgen examination on the day of his discharge gave the following report: "Lung markings are still exaggerated but there is continued improvement." The physical examination of the chest revealed both sides practically normal.

Case 11. W. D., a male aged forty-three, was admitted to the hospital with a fracture of the right leg, which he received while at work

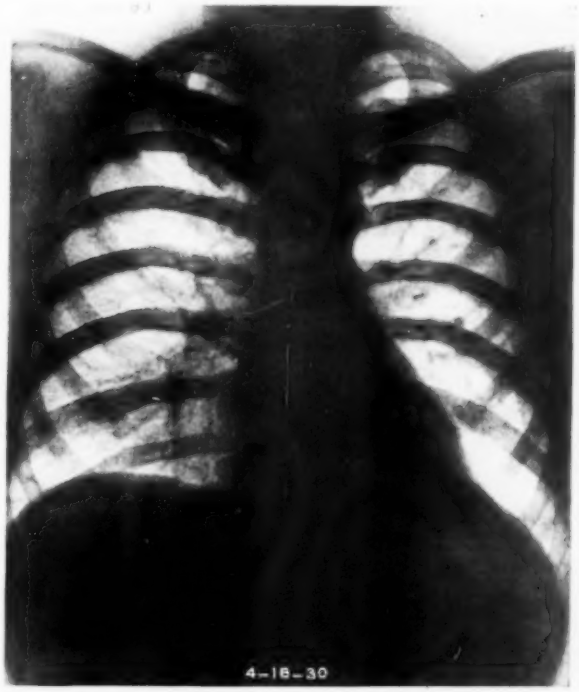

Fig. 5. C. McM. Roentgenogram by Dr. W. E. Reiley taken on patient's discharge from hospital. Right lung almost clear.

by falling through a trestle, a distance of 12 ft. He also complained of a severe cold and bronchitis at that time. He was put to bed and following roentgen examination the limb was put up in extension. Physical examination revealed a rather poorly nourished male. Eyes, ears and nose were normal; throat markedly injected and red; there was some impairment present over the hilum areas; the heart was normal; abdomen normal. The temperature was 98.2°F., pulse rate 84, respiratory rate 20. On examination of the blood the hemoglobin was found to be 75 per cent, erythrocytes numbered 3,850,000, leucocytes 17,000, polymorphonuclears 85, small lymphocytes 10, large lymphocytes 4, transitionals 1. The urea-nitrogen 13.54 mg., creatinine 1.66 mg., sugar 100 mg. The patient's condition improved as the temperature, pulse and respiratory rates remained within normal limits for a period of four weeks. During this time he had a cough with considerable expectoration. Four weeks following admission he complained of a chill which was followed by a rise in temperature to 103.2°F., pulse 130, respiration 30.

Physical examination of the chest revealed

an area of consolidation about the size of a half dollar in the left lower base. The next morning he became very restless, dyspneic and cyanosed. was twisted on itself and removed. As the sponge was brought out a large gelatinous plug was found to have adhered to it. The

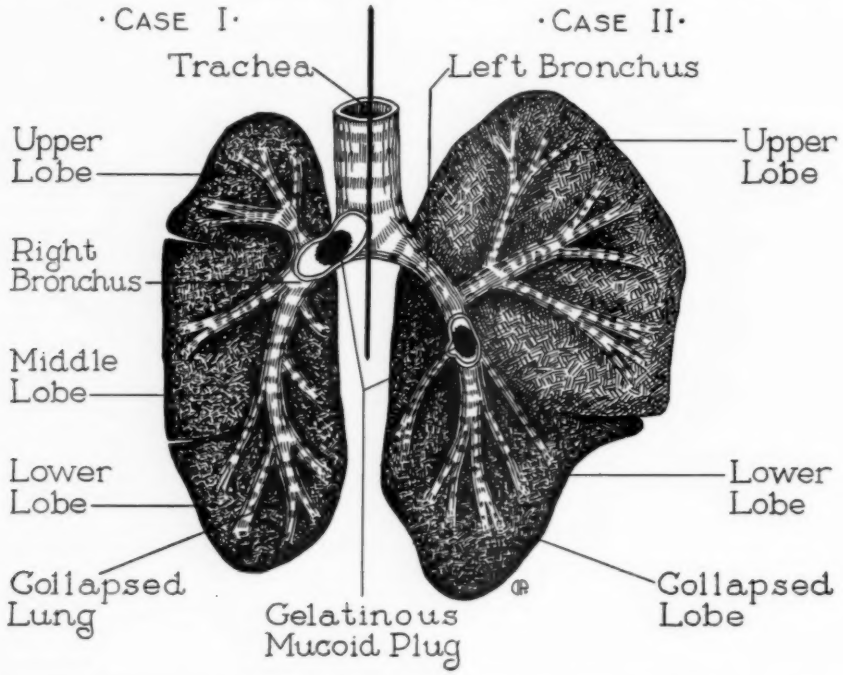

FIG. 6. Illustration showing mucoid plug and part of lung collapsed in each case.

The temperature rose to 104.2°F., pulse became more rapid and weak. There was marked limitation of movement of the left chest. The note over the upper half of the left lung was hyperresonant, while at the base over an area about the size of a small orange there was dullness outside of which the note was tympanitic.

Roentgen-ray examination gave the following report: "Left inferior lobe very cloudy, upper lobe appears normal. The appearance suggests massive collapse. The heart is displaced toward the affected side." After consultation with the bronchoscopic department it was decided to do a bronchoscopic examination. One hour later bronchoscopy was done with the following report: mucous membrane of posterior pharanyx dry and injected; glottic chink and vocal cords normal; mucous membrane of trachea and right bronchus was pale and rather dry. The bronchoscope was passed to the carina, thence into the left bronchus. About 3 cm. below the bifurcation an obstruction was seen that partially occluded the bronchus. The aspirator tube was put down to the obstructing area but nothing was obtained, as the substance was apparently too gelatinous. A sponge was then passed down the bronchoscope and as it reached the obstructed area it aspirating tube was again put down to the left bronchus through which about 1 oz. of thick dirty material was aspirated into a modified Luken's aspirator. The patient immediately began breathing without difficulty and cyanosis disappeared. Movement of the left chest again occurred and several minutes later breath sounds could be heard over the left lung. The laboratory report of the specimen: "Thick muco-purulent material; many pneumococci and streptococci."

The following morning the temperature dropped to normal as did also the pulse and respiratory rates. Roentgen-ray examination sixteen hours after bronchoscopy gave the following report: "Appearance of left lung has improved, lower lobe not entirely clear." The patient remained in the hospital three weeks longer with no recurrence of symptoms.

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BACILLUS FECALIS ALKALIGENES MENINGITIS*

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BECAUSE I have been unable to find anything in the literature about B. fecalis alkaligenes meningitis and as there is very little about other infections produced by this organism, I believe a report of the following case should be on record.

M. K., a boy thirteen years old, entered the Presbyterian Hospital, June 18, 1928. His chief complaints were: recurrent spasmodic contractions of the left side of his face, arm and leg, with headaches and dizziness occasionally followed by salivation and unconsciousness. When one and one-half years old, the patient fell from a porch receiving a severe blow on the head. He was in a hospital for one week and his doctor reported that he had skull fracture. Subsequently, a large hard lump developed. Except for an attack of rheumatism when he was six years old, the boy has been in good health. At the age of ten, he began to have headaches and later occasional twitching of the left side of his body. These would last for two or three minutes and occur two or three times a month. About two years ago, there occurred a period of freedom from attacks, lasting six months. For the past eighteen months, the attacks had increased in frequency and severity so that upon admission to the hospital, he was having several a week. A typical attack began with contractions of the muscles in the left side of the face and drawing the corner of the mouth outward. The left arm would then become rigid and finally the left leg. The average attack lasted about three minutes and, according to his mother, the patient was conscious during most of them. After an attack the patient complained of general weakness and he usually slept for fifteen to thirty minutes. A dull aching pain over the right eye would persist for fifteen to twenty hours. The boy's mother knew of no definite exciting cause for the attacks. Dizziness usually followed the attacks and occasionally nausea and vomiting. Strabismus has been present as far back as the mother can remember. His history was otherwise negative except for anesthesia of the right index and middle fingers following a lacerated wound of the wrist which occurred in April, 1928. The family history was negative for insanity or epilepsy.

On examination, there was a visible and palpable bony protuberance in the right parietal region measuring about 4 cm. in its transverse diameter. The left arm and hand were slightly smaller than the right but functioned normally. The arm measured from the tip of the acromion to the tip of the middle finger 2 cm. less than the right arm. The left arm was definitely weaker than the right. The left elbow and knee reflexes were slightly stronger than the right. Other reflexes were normal. Sensation was normal except for the anesthesia over the lateral half of the volar surface of the right hand excluding the thumb, evidently the result of recent injury. Ophthalmological examination was negative except for an alternating squint. *X*-ray films showed a definite thickening of the skull in the right parietal region with what appeared to be the remains of an old stellate fracture about 4 cm. from the midline in the neighborhood of the fissure of Rolando.

The diagnosis of Jacksonian epilepsy, probably the result of a depressed skull fracture, was made. Since the patient was right-handed and there seemed to be little danger of producing new symptoms by operation, an exploratory craniotomy over the right Rolandic area was done on June 28, 1928. An osteoplastic flap was turned down. Some difficulty was encountered owing to the depression and thickening of the bone in the region of the injury. The dura was adherent at this point and there were a number of irregular spurs of bone on the dural side of the flap. Although no undue bleeding had been encountered, the patient showed signs of shock and the operation was discontinued. On July 5, the patient having made an excellent operative recovery, the stitches were removed and the flap separated by blunt dissection. A very soft area was found in the anterior-superior portion of the wound beneath

* From the Department of Surgery, Rush Medical College of the University of Chicago, and Presbyterian Hospital of Chicago. Submitted for publication October 9, 1930.

a thickened scarred dura. With an aspirating needle a brownish turbid fluid was withdrawn. The opening was widened and found to be a cyst about the size of an English walnut with a thin smooth lining. An opening was accidently made through this exceedingly thin wall exposing the lateral ventricle and furnishing an excellent view of the foramen of Monro. A considerable amount of clear spinal fluid escaped. The dura posterior to the cystic area was firmly adherent to the brain. It was freed and removed for a distance of about 3 cm. The brain beneath this was whiter than the surrounding tissue. The irregularities on the inner surface of the bone flap were carefully removed and the flap replaced without an attempt to close the dural defect.

The following day, the patient began to run a septic temperature varying from 101° to 103°F. The scalp wound remained clean but the dressings were saturated with cerebrospinal fluid requiring daily change of dressings for about eight days. On July 16, eleven days after operation, the patient had a positive Kernig's sign. He began to vomit and his disks appeared slightly blurred. An unsuccessful attempt was made to reestablish drainage from the wound. The patient's condition remained practically the same except for a slight stiffness in the neck until July 19, when at Dr. Bassoe's suggestion, spinal puncture was made and 30 c.c. of turbid fluid were withdrawn. There was no marked increase in pressure. This fluid showed 4780 cells per c. mm. with both polymorphonuclear leucocytes and lymphocytes present; a positive Nonne and gold chloride, 0013321000. In smears, a gram negative short bacillus was found. This organism proved to have all the cultural characteristics of B. fecalis alkaligenes. The patient's temperature dropped immediately after the spinal puncture and stayed normal for the ten days he remained in the hospital. He had had a number of attacks preceding the spinal puncture and none afterward. The patient has now gone over six months without any recurrence of symptoms.

According to Stitt,[1] B. fecalis alkaligenes is a frequent inhabitant of the intestinal tract. It has been isolated in the blood in a few cases resembling typhoid fever. Fürth,[2] in 1913, reported 6 cases of typhoid-like disease in which the B. fecalis alkaligenes was obtained and in which agglutination occurred for this organism, but not for typhoid or paratyphoid. The organism is usually considered non-pathogenic and Kendall[3] states that animal experimentation has been uniformly negative. As it culturally and clinically resembles paratyphoid, I looked over the literature on paratyphoid meningitis and found that in 1925, Bradhy,[4] reported the first case in English literature. He cited 7 others, the 1 reported by Walterhöfer[5] being of particular interest. This case occurred in a soldier of twenty, who received a rather minor cranial injury. Paratyphoid bacillus was obtained in pure culture from lumbar puncture with over 3000 leucocytes and lymphocytes in a turbid spinal fluid. Following the third spinal puncture, the patient's temperature dropped immediately to normal and he went on to a good recovery.

SUMMARY

This is the report of a case of Jacksonian epilepsy due to a traumatic brain cyst following skull fracture. B. fecalis alkaligenes meningitis followed operation. The patient made an uninterrupted recovery after spinal puncture. Attention is called to the similarity of the clinical picture with that of B. paratyphosus, B. meningitis. As far as I am aware, this is the first case of B. fecalis alkaligenes meningitis to be reported.

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SURGICAL TREATMENT OF CARCINOMA OF THE THORACIC ESOPHAGUS WITH REPORT OF A CASE*

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MINNEAPOLIS, MINN.

IT is recognized by all engaged in the treatment of carcinoma of the thoracic esophagus that unless the growth is completely removed surgically the mortality is 100 per cent.

The difficulties which face the surgeon are many and very great: the inaccessibility of the organ; its anatomic relations and its anatomic structure; the absence especially of a serous coat and the poor blood supply which account for the frequency of necrosis and danger of postoperative infection of the neck, mediastinum, pleura and lung; the proximity of the vagi nerves; the presence of the diaphragm which prevents approach from below. Finally, it must be acknowledged that carcinoma of the esophagus is highly malignant and that the numerous operations devised are all followed by a fearfully high mortality, all of which taxes the courage of the surgeon.

These patients are in poor condition. Necessarily, the preoperative care is somewhat prolonged, and often the gastrostomy with forced feeding precedes by several weeks or months the final desperate attempt to remove the cancerous growth. In feeding by gastrostomy, milk, cream, sugar, orange juice, cod liver oil and stew made of meat, spinach and gravy will give a diet of protein, fats, carbohydrates, iron and vitamines. Even with the slight gain in weight which is always aimed at prior to the thoracic operation, the patient is a poor surgical risk. The problem, then, is to subject a poor surgical risk to a stupendous operation.

It was in 1738 that Goursald performed the first operation on the esophagus. He removed a foreign body from the cervical portion, the part of the organ easiest to approach. It was not until 1888, 150 years later, that Nasiloff devised his mediastinal approach on the cadaver which was modified by Bryant in 1895 to the quadrilateral flap. Only thirty-two years ago, in 1898, Rehn first attempted the removal of a carcinoma of the thoracic esophagus in the living human. Since that time, the following methods of procedure, among others, have been devised in the effort to deal more safely with this disease.

1. The extrapleural dorsal approach with endeavors to reconstruct the lumen by suture end-to-end (or esophagogastrostomy).

2. Transpleural approach under differential pressure with attempts to restore the tube with or without transposition of the stomach by suture, buttons, or other methods.

3. Transpleural removal of the whole esophagus, placing the stump outside from an incision in the neck, and later reconstruction of the esophagus by plastic operation.

4. Extrapleural removal through invagination of the entire esophagus by combined method from abdomen and neck.

5. Extrapleural removal by a combined method from the abdomen and neck, or abdomen back and neck, with transposition of the stomach into the posterior mediastinum.

6. Dorsal approach and plastic repair by fascial transplants or grafts.

Some of these operations will result in strictures, and, because of poor blood supply, in sloughing or necrosis. Of the operations performed, the only intrathoracic procedures which have proved successful are those of Torek, Lilienthal

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and Eggers, the last of whom has had two successes.

In the selection of a surgical procedure, it would be unwise to choose a method which seems less radical if, by so doing, one offers to the patient an impracticable operation. The one operation which has proved most successful is that of Torek. Of approximately fifty known efforts and of four successful operations, Torek's method has been successful three times. If one includes carcinoma of the cardiac end of the stomach, other operations utilizing the same approach have been successful. The advantages of this operation are that it gives a wide exposure of the thorax, as the entire length of the esophagus lies in view. Any bleeding may be stopped at once. The lymphatics of the mediastinum are under inspection and a most extensive resection may be made with the least trauma and the most accurate observation.

The selection of anesthesia is very important. Sodium amytal or preliminary narcosis is beneficial, as it reduces the amounts of other anesthetic agents required. Pressure anesthesia is not absolutely necessary but it is wise to have it handy in case of need. Eggers states that inflating the lung frequently during the operation is effective in preventing pneumonia, and the lungs should be inflated without failure at the end of the operation, when the closure is attended by obliteration of the pleural cavity through adhesions of the lung to the thoracic wall. We believe that injecting the nerve supply of the field with novocaine, while sometimes of too short duration for the operation, will reduce the shock incident to opening the thorax. Novocaine with gas is ideal, while ether may be used if necessary. Ethylene may be equally good; in the minds of some, superior. Spinal anesthesia in its present development is not the safest type of anesthesia for the thoracic surgeon. The influence of the anesthetic on the postoperative recovery is profound.

CASE REPORT

A married woman, fifty-eight years old, with a history of previous excellent health was admitted to the New Asbury Hospital, February 15, 1930. Since August, 1929, she had been unable to swallow solid foods and upon admission was unable to swallow liquids. She had gradually lost weight from 189 to 108 lb. Some of the eye signs of hyperthyroidism were present, but the basal metabolism was plus eight. *X*-ray of the esophagus showed complete obstruction at the level of the tenth thoracic vertebra. The aorta was apparently normal. The following day, a Janeway gastrostomy was performed and a careful search made for metastases in the liver and lymphatics of the lesser curvature of the stomach.

On February 23, the patient weighed 120 lb., having made a gain chiefly through increase in fluid intake. On that day Dr. J. A. Myers injected 400 c.c. of air into the left pleural cavity; on February 24, 300 c.c., and on February 26, 500 c.c., at which time there was complete collapse of the left lung and positive pressure in the left pleural cavity of 0 to 3 atmospheres. On February 27, the thoracic operation was undertaken.

After inducing narcosis with a No. 1 H.M.C. hypodermic at 6:30 A.M. and a No. 2 at 7:30, at 8:00 A.M. novocaine blocking was performed of the left brachial plexus and the right eighth, seventh, sixth, fifth and fourth ribs. The incision started at the midclavicular line extending posteriorly through the seventh intercostal space to the tubular of the rib (paravertebral line) and upward through the seventh, sixth, fifth, and fourth ribs. The intercostal vessels on both sides were ligated and the pleura opened throughout the extent of this incision. This was accomplished under local anesthesia, but when attempt was made to manipulate within the chest, the respiratory reaction was so marked that the patient was placed under nitrous oxide. This was given without pressure. Rubber sheets were placed over the parietal and visceral pleura and the aorta and heart identified. Between these two structures an incision was made into the pleura posterior to the hilus of the lung which was carried from the diaphragm to the lower part of the arch of the aorta. Through this opening, the esophagus was recognized and felt to be a solid, hard, fusiform mass. The left vagus was observed at its upper end,

but was found to be involved in the carcinoma and later in the dissection had to be sacrificed 2 cm. above the diaphragm. The esophagus was easily liberated from the surrounding tissues and was divided from the stomach at the level of the diaphragm. This section was made by cautery between two ligatures. The lower end was inverted by a purse-string, which again was reinverted. The ligature on the upper stump slipped off and left exposed an area of carcinoma about the size of a dollar. This was covered by a rubber glove and ligated. In the subsequent dissection, the glove slipped off and another glove was applied and two ligatures placed. Section was made of the pleura above the arch of the aorta, the esophagus separated from its surroundings, care being taken to stay close to the organ, and not to injure the thoracic duct.

The dissection under the arch of the aorta and bifurcation of the trachea was most delicate. This was made from below upward, and from behind forward on each side loosening the branches of the vagus nerves without injury to the fibers passing to the pulmonary and cardiac plexuses. The esophagus was thus freed throughout its entire extent, but the mass was too large to draw under the arch of the aorta, especially since it must remain covered by the glove. So it was again sectioned between two ligatures above the tumor just below the arch of the aorta. The upper stump was drawn out above, through an incision in the neck just above the sternum, using blunt dissection and keeping close to the trachea to avoid the recurrent laryngeal nerve. There was just enough esophagus to reach the skin surface. One drain was passed through this opening into the posterior mediastinum. The pleura was closed using No. 00 plain catgut, and the ribs were brought into approximation with chromic No. 2. The muscles were closed from below upward: the anterior serratus, latissimus dorsi, trapezius, rhomboideus major, lower portion of the posterior superior serratus. Then the fat was closed with No. 1 plain Catgut and the skin with dermal.

The patient's pulse did not vary during the operation, and the only reaction she seemed to have was a respiratory one from manipulation. Postoperatively, morphine and fluids intravenously and under the skin were given. The second day, forty-eight hours after the operation, the patient was in excellent condition and she was allowed to wash the esophagus through with drinks of various sorts. On the afternoon of that day she suddenly collapsed, and expressed the desire to die, which she did the following (third postoperative) day.

Autopsy showed the stomach sutured in the anterior abdominal wall, the opening in the anterior wall near the greater curvature. The curvatures were intact and there was no sloughing. There was no peritonitis. The diaphragm was at the fourth rib on the right and the fourth interspace on the left. The left lung was completely collapsed and firmly adherent to the posterior wall. There was a marked fibrinopurulent exudate over the entire left chest and the collapsed lung, and a foul smelling greenish exudate. On the right, the pleura was normal. The pericardial sac was normal with a normal amount of fluid. The left lung weighed 250 gm. It was adherent to the pericardium and to the chest wall posteriorly. On section it was deep red and fleshy; a small amount of fluid and blood was expressed, but no pus. The right lung weighed 500 gm. Crepitation was present throughout but reduced in the base. No nodular areas could be felt. On section, blood and fluid were present but no pus was demonstrated. The liver, heart, spleen and kidneys were normal. The esophagus was entirely absent. The stomach sutures where the esophagus was removed had held. There were no enlarged nodes near the stomach or in the mesentery, cervical or clavicular regions. In the region of the anterior mediastinum the tissues were necrotic and covered with foul smelling purulent exudate, thick and greenish yellow, near the point of attachment of the esophagus to the skin of the neck. No evidence of carcinoma could be demonstrated anywhere.

There were four sources of exposure to infection in this patient: (1) Section below the tumor with slip of the ligature: (2) section above the tumor; (3) cut end of esophagus on the skin surface with the drain leading to the mediastinum; (4) drinking of fluids forty-eight hours after the operation.

This operation is a feasible one for carcinoma of the thoracic portion of the esophagus. There is no doubt but that it is an heroic measure. Broders and Vinson have classified these carcinomas as 90 per cent in grades 3 and 4. This seems to be corroborated clinically. Of those patients

who do not die at or shortly after the operation, very few survive more than fifteen to sixteen months. It must be noted, though, that the cause of death is recurrence, not metastases. Torek's patient was living eleven and one-half years after operation.

It is only thirty-two years since the first attempt was made to offer surgical relief for carcinoma of the thoracic esophagus. In that time, many observations have been recorded making more certain a definite progress in success of treatment for this condition.

There are three suggestions to be offered from a study of this case, which may be considered contributions to the successful management of surgical treatment for carcinoma of the esophagus.

1. Preliminary artificial (closed) pneumothorax will allow rapid opening of the entire thorax without danger of shock. While artificial pneumothorax has been used in other types of thoracic surgery, it has not previously been recommended for esophagectomy. This removes one of the causes of death and is vital if the best results are to be obtained. There is little danger with this procedure and following closure, the air must be removed from the pleural cavity to allow the lung to expand. In the case reported, the air was not removed postoperatively, and this fact may have had some part in the death of the patient. There may be certain objections to this procedure, the feeling that the preliminary reduction of vital capacity may reduce the strength of the patient. The inflation of the lungs, as recommended by Eggers to prevent pneumonia, may still be conducted. The chief purpose of the pneumothorax is to permit rapid opening of the thorax with less danger to the patient.

2. Ligatures should be placed on the esophagus below the tumor, from above downward. The ligature on the upper stump is left long as a tractor in handling as it passes through the neck.

3. After the stump of the esophagus has been brought through the skin at the suprasternal notch, the cancer may be removed below a ligature which should not be removed, but allowed to remain closed for a period of at least three days to allow healing; and better seven days. This removes one great cause of infection through mediastinal leakage. Eggers considers this of less value than the preliminary artificial pneumothorax. If these three procedures are utilized together with the technique already advanced, a definite decrease in operative and postoperative mortality will result. They will also shorten the operation by allowing rapid opening and more rapid dissection. The only possible danger of infection under these circumstances would be a rupture of the esophagus.

There are six recognized causes of death:

1. Shock from opening the thorax. This may be avoided by preliminary closed pneumothorax.

2. Surgical shock. This usually results from bleeding and exposure, and may be avoided by preliminary narcosis with some barbituric acid compound and hemostasis. Keeping the room warm and free from draughts will aid greatly, as will also the rapid removal of the cancer facilitated by preliminary pneumothorax.

3. The dissection itself. The vagi nerves are unquestionably the most important structure encountered. Sauerbruch expressed the view that removal of the thoracic esophagus is impracticable because of the danger of injury to the vagus nerves. The greatest care is needed during the liberation of the esophagus from under the arch of the aorta and the bifurcation of the trachea. Study of the anatomy of the vagi gives a clue as to how to proceed. If the nerves are dealt with separately and dissected from behind forward, there is least likelihood of injuring the fibers passing to the cardiac and pulmonary plexuses. If the nerves must be cut at any level, it should be as low as possible and done by sharp dissection. The nerves should not be cut above the fifth thoracic vertebra.

One should have at hand emergency stimulants such as coramine and adrenalin. The great danger arises from disturbance of the cardiac or respiratory fibers in their respective plexuses. The vagi nerves above the arch of the aorta are somewhat farther from the esophagus and not likely to be harmed with any degree of care during the dissection. The recurrent laryngeal nerve is also present but not liable to injury. The thoracic duct may be injured in the superior mediastinum. By adhering to the esophagus, one is fairly safe. Injury to the thoracic duct may render infection more probable.

4. Infection is the most serious of all complications and will follow the operation if there is any possible excuse for it. Willy Meyer states that only good fortune permitted Torek to close his successful case without drainage. Eggers drained both of his cases. Infection of the mediastinum and pleura, from opening the esophagus within the thorax, is the most obvious danger. The effort has been made to open the mediastinum extrapleurally to avoid pleural contamination. However, this makes the surgical technique so much more difficult that the question may logically be raised as to the superiority of the extrapleural method. The greater success of the transpleural technique is further evidence against the advisability of the extrapleural approach. Eggers and his co-workers, after further experience with the pleural stripping operation, question the superiority of this method over the transpleural Torek operation. To avoid infection, technical perfection is requisite with careful placement of ligatures, at no time allowing the open esophagus to expose its contents to the pleura or mediastinum. During the thoracic operation protection of the pleura from exposure and friction may be exercised by placing rubber over the parietal and visceral pleurae. The possibility of infection of the mediastinum and pleura is also decreased by leaving the stump closed until complete healing has occurred at the neck. If these points are observed, it is not necessary to drain, as there is no exposure to infection granting that the surgeon has been careful in his technique. When drainage is used, it is best placed in the thoracic cavity below the sixth rib in the posterior axillary line. The barrel shape of the thorax makes this the most dependent part of the pleural sac. Any air left in the thorax after the operation should be removed by negative pressure. Eggers has made it a point to *x*-ray his cases in order to observe the presence of fluid. His study shows that the visceral pleural becomes adherent to the parietal very quickly after closure.

5. Infection of the lung: pneumonia. To prevent aspiration pneumonia, the esophagus should be emptied at the start of the operation. It may be advisable to leave a tube in the esophagus during the entire operation. If emptied at the start, it does not usually fil under the lanesthesia. The selection of anesthesia is vital, and rapid dissection to reduce the amount of anesthesia needed. Preliminary narcosis and opening under local anesthesia will also decrease the total inhalation anesthesia. Eggers recommends inflation of the lungs at frequent intervals as a fine preventive of postoperative pneumonia. This was not done at our operation, but should be accomplished in every case at the close of the operation. Removal of the air by negative pressure, allowing the lung to expand following operation, may serve as well as positive pressure. Tight strapping of the dressings prevents too much motion with its injury to the lungs from the severed ribs.

6. Recurrence of carcinoma. Very rarely does carcinoma of the esophagus metastasize, probably because of the poor blood supply and its loose relations with other thoracic organs. The earlier the carcinoma is diagnosed, the more possible is its complete removal. By bringing the patient to the table in the best possible condition and by being radical in removal of the carcinoma, the more hopeful is the outlook.

Rapid progress has been made in this

field, considering the few operations performed. Although it has been attended previously by high mortality, improvement in technique will markedly decrease this. In view of the absolute certainty of death from this disease without operation, surgical removal should be attempted in every case where there is no evidence of metastasis.

SUMMARY

At preliminary operation, a Janeway or Witzel gastrostomy is performed under local anesthesia and the liver and lymphatics in the region of the diaphragmatic esophagus are inspected. Two to six weeks being allowed for recovery and upbuilding of the patient, artificial pneumothorax is induced, the thorax is opened under narcosis and local anesthesia, using gas in addition if needed. Protecting the pleura with rubber sheets, the esophagus is dissected from its mediastinal bed and drawn out through the neck. Infinite care is taken to control hemostasis and protect the vagi nerves, consistent with complete removal of the carcinoma. Finally, all the air is removed from the thorax, the chest is tightly strapped, and healing allowed for seven days before the stump of the esophagus in the neck is opened. The patient may then be allowed to drink.

Postoperatively and preoperatively, the scientific use of the gastrostomy, and the administration of fluids by vein and subcutaneously will give these patients the most hopeful outlook from surgical treatment of carcinoma of the esophagus. Only by prompt diagnosis and early treatment will it be possible to offer these patients anything but a 100 per cent fatal prognosis.

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* Continued from p. 426.

POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG

REPORT OF A CASE*

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PULMONARY complications are among the most important postoperative problems. According to Scott about 3 per cent of all patients operated on, develop some type of pulmonary complication and one of every 200 operations results fatally from this cause. Notwithstanding the great interest in postoperative pulmonary complications there is a special group classified as massive collapse of the lung which has received slight attention. This condition presents itself as a definite clinical entity which in most instances escapes recognition. A description of this syndrome is found only in the "Oxford Medicine." None of the textbooks on surgery, gynecology, obstetrics, or postoperative care, mention it. Choyce and Keen briefly refer to it as a complication of gunshot wounds. Furthermore the etiology is not definitely accepted as proved although several brilliant papers have been written in an attempt to prove several widely different theories. Attention was first directed to it as a postoperative disturbance about 1908. The first case appeared in the American literature only as recently as 1922.

In 1854 Gairdner spoke of it as pseudopneumonic condensation of the lung. Pasteur characterized it as a total deflation of a large area of lung tissue of sudden onset due to failure of inspiratory power and attended by definite symptoms and physical signs. Scott in order to avoid confusion arising from the use of the word collapse, proposes the term active collapse to distinguish it from passive collapse which is due to compression. Coryllos and Birnbaum suggest as most appropriate obstructive massive apneumatosis of the lung. They believe there are only two kinds of collapse, acute, due to obstruction of a bronchus, and passive, from compression of a lung, e.g., pneumothorax.

The first description was given by Legendre and Bailly in 1844. They regarded it as a frequent complication of bronchitis in children and separated it from the inflammatory consolidations of the lung with which it was formerly confounded. Its cause is "partly the imperfect respiratory movements, and partly the obstruction of the bronchi with secretions. As air does not enter the lungs the alveoli collapse because of the elasticity of the lung parenchyma." Mendelssohn in 1844 produced atelectasis by obstructing bronchi with shot paper and gum arabic solution.

In 1846 Traube showed that artificial occlusion of a bronchial tube produced atelectasis of the corresponding portion of the lung and that the same phenomenon occurs when the thoracic cavity is opened. Gairdner in 1851 regarded obstruction of the bronchi with mucus as the most frequent cause of collapse. Barthels in 1860 first demonstrated mucous secretion in the bronchi corresponding to the atelectatic portion of the lung and later to the atelectasis of the bases following diphtheria. In 1879 Lichtheim obstructed bronchi with sticks of laminaria and produced collapse with absorption of the alveolar air by the circulating blood. He also established the speed of absorption of the different gases. Pasteur gave a new impetus to the study of this question. In a series of articles appearing between 1890 and 1914 he drew attention to the coincidence of collapse of the lung with paralysis of the diaphragm which he concluded was the principal factor in its production. Briscoe after an elaborate series of experiments concluded that massive collapse was the natural sequence of prolonged quiet breathing in the supine position in such people as do not use their abdominal muscles to fix their chests. Bradford in 1920 reported a case of contralateral collapse in a soldier

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with a superficial gunshot wound of the chest.

Chevalier Jackson and his associates have gone a long way towards clearing up the etiology of this perplexing syndrome. Their conclusions seem to corroborate the results of Caryllo's and Birnbaum's experiments carried out in the laboratories of Cornell Medical School. The latter have reported the results of a series of experiments on 56 dogs. Their results seem to make bronchial occlusion a primary cause and all other mentioned causes merely contributary factors. Lemon, in a recent paper, stated that he sectioned one or both phrenic nerves and did not find atelectasis either during life or at autopsy. This contradicts the conclusions of Pasteur.

Massive collapse of the lung is an unusual condition in which the lung without the presence of any gross lesion such as a bronchial obstruction, pleural effusion, etc., interfering with the free entry of air, becomes airless to a greater or less degree and therefore useless for respiratory purposes. It involves varying amounts of the lung in different cases, usually an entire lobe or the whole of one lung. Symptoms may be present or absent. Massive collapse is only seen as a complication of disease, injury or operation, is often overlooked and the signs found attributed to other causes. It is most often seen after abdominal operations. Impairment of the movements of the diaphragm may be a cause; prolonged anesthesia may induce the retention of secretions in the bronchial tubes and thus lead to its mechanical production. It has also been observed in cases where no anesthetic has been given. Non-penetrating wounds limited to the abdominal wall may also produce it and it is occasionally seen as a complication of wounds of the buttocks, pelvis, and thighs.

The most important physical sign is displacement of the cardiac impulse to the affected side. It may be found on the left in the axillary line and in right-sided involvement as far over as the nipple line. The impulse may also be displaced upward as far as the third rib. The affected side is retracted and immobile. The diaphragm of the collapsed side is displaced upward and immobile. Roentgenologic findings have confirmed this (Sante). The percussion is impaired. Dullness marked in amount may be present up to the level of the clavicle. Two groups of cases may be recognized: one with diminished or absent tactile fremitus and breath sounds, and one with increased tactile fremitus together with tubular or amphoric breathing and with bronchophony and pectoriloquy. In both cases extreme displacement of the heart is present. The majority of the cases conform to the type with increased tactile fremitus and tubular breathing. The signs are apt to change in one and the same case; thus at first weak or absent breath sounds may be present, and twenty-four hours later these are replaced by loud tubular or amphoric breathing, with increased tactile fremitus. Sometimes a change takes place so that tubular breathing is replaced by weak or absent breath sounds and such alterations may take place more than once in the clinical course of the case. These repeated alterations are evidently dependent upon variations in the patency of the bronchial tubes. The symptoms vary in severity in different cases, and on the whole tend to be most marked at the onset of the condition. It is important to remember that massive collapse may involve the whole of one lung without the presence of any urgent symptoms, and the condition may be overlooked unless the chest is carefully examined. Scott found 10 per cent of his collected cases had no symptoms. Dyspnea is the most constant symptom in massive collapse; it is sometimes comparable to that seen in pulmonary embolism. Pain in the chest, cough, mucopurulent expectoration, and cyanosis are usually present. The termination takes place either by lysis or crisis. The presence of infected emboli in the involved area may cause infarcts with a resultant bronchopneumonia. The latter generally terminates

fatally. Lee believes that over 70 per cent of all postoperative complications are some variety of massive collapse.

Treatment is mostly symptomatic. If mucus is present aspiration through a bronchoscope is most effective.

Caryllos and Birnbaum have collected 118 cases from the literature with 30 deaths. Jackson and Lee reported a cesarean section in a woman eighteen years old with a sudden pulmonary complication appearing on the third day. Death occurred in six hours. Partial collapse of the right and left lungs at the base, local peritonitis, paralytic ileus, hydronephrosis, and thick mucopus in the left lower bronchus were found at autopsy.

Bergamini and Shepard reported a case of a woman sixty-nine years old on whom a laparotomy was performed. Exodus took place at the end of the operation. The autopsy revealed a massive collapse of both lungs.

These are the only cases I could find in the literature which are in any way similar to the case reported here.

My case report deals with a primiparous negress twenty-four years old. The family and previous personal history had no relation to the obstetrical problem which was presented during the first stage of labor. There were no subjective or objective evidences of disease present at the physical examination. Blood pressure was 98/54. The patient was admitted to the hospital having pains every five minutes. Her pains had commenced eight days previous to admission.

The cervix was 5 cm. dilated, with cephalic presentation, and the caput protruding well into the cervical canal. The head was unengaged. Abdominally a well marked contraction ring was easily palpable 7 cm. above the symphysis. The lower uterine segment was very thin and the right lower quadrant of the abdomen was exquisitely tender, suggesting possible rupture. The fetal heart was 140.

Low cesarean section was decided upon and successfully carried out, with the use of the Beck technique, and a living male was delivered. The time of the operation was forty-five minutes.

At six P.M. the same evening the pulse was 130, and a large blood clot appeared at the vulva. At midnight the temperature was 101.6°F., respirations 38, pulse 136. During the night the patient became dyspneic, with an apical pulse of 160. She was restless and tossed about constantly.

At 7.30 A.M. next morning the radial pulse was scarcely perceptible; apical pulse was 160 and weak; dyspnea had increased and she complained of pain in the chest. Temperature was 102°F., pulse 160, respirations 45. Preparations were made for a blood transfusion but excitus took place at 7.55 A.M. The probable cause of death at this time was internal hemorrhage and pulmonary embolus.

Autopsy findings were as follows: Heart: pericardium negative, right auricle and ventricle markedly dilated containing red clots, myocardium paler than normal with cloudy swelling.

Lungs: Massive collapse of both lungs: bases of both lungs at level of fourth. Right lung weighs 300 gm.; left lung 250 gm. The diaphragm was at the level of the fourth rib on both sides. Right lower lobe showed five recent infarcts (red). No evidence of pulmonary embolism. Pleural cavity negative. No evidence of obstruction in the bronchi or bronchioles. Microscopic section showed areas of collapse with other areas of normal alveoli.

Uterus: No evidence of hemorrhage or infection along the line of the incision. The organ was globular, firm, and contracted. Cavity contained few dark red clots and small segment of placental tissue.

Spleen: A few red infarcts were present. All the other organs were normal. Cause of death: massive collapse of the lungs.

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TRAUMATIC RUPTURE OF THE CORPORA CAVERNOSA

REPORT OF A CASE*

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TRAUMATIC rupture of the penis, also designated by the obsolete term "fracture of the penis," although a rare clinical entity occasionally does occur. The lesion consists chiefly of a tear in the fibrous sheath of the corpora cavernosa. The condition always occurs during erection and is usually due to a sudden rough bending of the penis downward toward the thighs. It may result from a direct blow. In some cases the corpora with their sheaths are weakened as a result of some previous disease and are therefore more susceptible to rupture.

When rupture occurs, there is a sudden pain at the site of injury associated with a crackling sound. The penis soon begins to swell due to the escape of blood into the subcutaneous tissues and reaches an immense size. The pain soon subsides and there is a feeling of fullness. The penis is bent toward the uninjured side. The ecchymosis gradually disappears, but a scar may result which may interfere with coitus. Suppuration due to a broken-down blood clot may occur.

Before presenting this case, I would like to refresh your minds with the anatomy of the penis, by reviewing briefly some of the anatomical factors involved. The main portion is made up of three elastic bodies, separated from each other by envelopes of strong, fibrous tissue. The two corpora cavernosa which lie side by side, occupy the dorsal position and comprise fully two-thirds of the organ. In the angle formed by their apposition, is the corpus spongiosum through which passes the urethra.

The corpora cavernosa are widely separated behind but are in close contact in the major portion of the organ. They arise on each side from the ascending ramus of the ischium, converge rapidly and meet just in front of the arch of the symphysis pubis. The corpora cavernosa are invested by a dense fibro-elastic sheath, or tunica albuginea which is rather tough and strong. It consists of two layers, an outer layer of longitudinal fibers and an inner layer of circular fibers. The inner layer of the tunica gives off numerous fibrous septa, which anastamose freely to form irregular spaces or areolae. They contain connective tissue, elastic and unstriped muscle fibers, and form the supporting framework for the blood vessels.

The corpus spongiosum, which is composed of erectile tissue, is subdivided into bulb, body and glans. In addition to the sheath which envelopes the corpora cavernosa and spongiosum, external to these is another sheath which binds all the structures together and is known as Buck's fascia or fascia penis. The two rounded extremities of the corpora cavernosa are completely invested by this covering which is attached firmly to the base of the glans, and at the angle of the penis where it joins the suspensory ligament above and the deep layer of the superficial fascia below. It will be noted that the arteries of the penis supplying the erectile tissue and the envelopes, are all branches of the internal pudic, except the small external pudic branches of the common iliac, which supply blood to the envelopes only.

J. G., aged thirty, white, single, a jeweler by profession, appeared at my office September 23, 1929, in a very much excited condition. His face was pale, the skin bathed in a cold perspiration, pulse was fast but regular, and he appeared worried. He was given some aromatic spirits of ammonia and in a few moments stated that he felt much better. He then began with the following narrative, which hr in all sincerity swears is the truth. About one-half hour previous to his visit to my office, he stated that he felt a desire to move his bowels and

* Presented at a meeting of the Fulton County Medical Society, October 2, 1930.

went to the toilet. He assumed his usual posture on the toilet seat and during the act, tried to force his penis, which was fully erect at the time, downward into the bowl. Suddenly, he felt a crackling sensation in the shaft of his penis and there was a sudden severe pain at the point of injury. He became very much frightened and watched anxiously for developments. The entire penis soon became swollen and edematous, and assumed a bluish-reddish discoloration which also extended to the entire scrotum and inner surfaces of the thighs.

Physical examination, which was limited to to the genitourinary tract, revealed the following findings. The penis was enormously swollen and slightly bent toward the right. The entire organ showed a bluish-red discoloration, which extended toward the scrotum and inner surfaces of the thighs, due unquestionably to the escape of blood throughout the subcutaneous tissues. The patient had difficulty in urinating. Because of the edema and swelling, it was rather difficult to palpate the organ and it was deemed advisable to put the patient in bed and observe him closely. However, I at first satisfied myself that the urethra was intact, as a small catheter entered the bladder without encountering any obstruction and there was no sign of urinary extravasation. The penis was elevated and cold compresses continuously applied. Morphine sulphate grains $\frac{1}{8}$, and atropine grains $\frac{1}{150}$ were given. The swelling and ecchymosis persisted for about eight days and slowly began to subside. The patient remained in bed during all this time and then reported to the office. Some discoloration was still present but the penis had almost assumed its normal size. Upon palpation of the organ I could distinctly feel on the left side of the penile shaft a small hard, fibrous structure, evidently a scar resulting from the rupture. This did not cause the patient any pain unless the penis became erect. In the meantime he was seen daily and diathermy treatments applied for the purpose of softening the fibrous scar, which responded very well. During the course of the treatments, he was also observed by Dr. Omar Elder, the latter advising treatments to be continued along the same lines as were being pursued. On October 15, an abscess which developed upon the dorsum of the penis, due to a broken-down blood clot, was incised and drained. Healing took place rather promptly and the patient soon made an uneventful recovery without having any sign of deformity present. The scar at the present time is hardly palpable and a vacuum cup applied over the penis showed that erection was entirely normal, there being no lateral deformity.

The penis is subject to contusions, rupture, lacerations, incised and punctured wounds, luxation and strangulation. Traumatic rupture of the corpora cavernosa is looked upon by many members of the medical profession in a more or less humorous way, but although it is rare, it is a condition that may sometimes occur and may be followed by serious complications. The seriousness depends upon whether the urethra is injured or the erectile bodies ruptured. If the rupture is severe, scar formation and tendency to lateral deformity of the penis may result, which will interfere with coitus.

It is my opinion that the patient was rather fortunate, in view of the fact that the corpus sustained a slight rupture and left a small scar which evidently is slowly becoming absorbed. However, the prognosis should always be guarded. When an injury of this character occurs, one must make sure that the urethra is intact. If rupture of the urethra occurs, appropriate treatment should be carried out. The effusion of blood which always occurs in rupture of the corpora, provided that the rupture is not severe, as a rule will subside if the patient is at rest in bed, with the penis elevated and cold compresses applied. If the effusion continues, incision, ligation of the vessels, and suturing of the sheath should be resorted to.

C. Otis Rich[3] reports a case where a revolver bullet became imbedded in the shaft of the penis in a white male, age twenty-six. After removal of the bullet there was left a lateral deformity and erection was painful. Cases of penile injury have been reported by William S. Ehrich and others.

In conclusion I would like to emphasize the fact that conservatism rather than radical procedures should be employed.

[For References see p. 457.]

TUNNELING METHOD OF SPINAL FIXATION*

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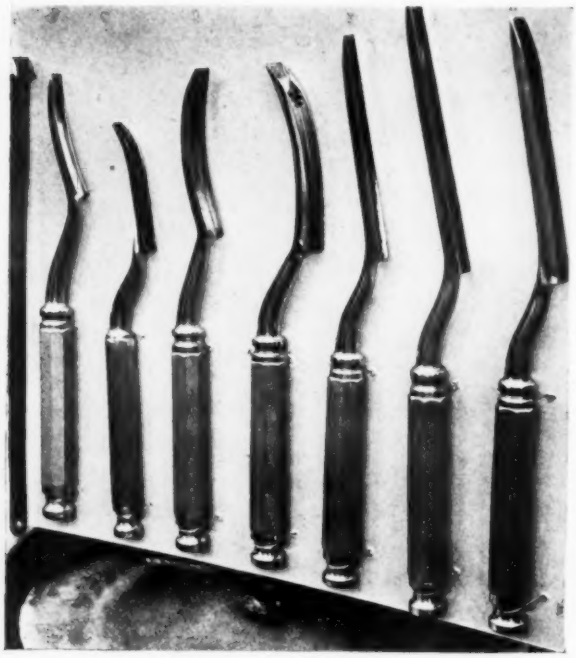
JOPLIN, MO.

AS our concept of the requirements in spinal fixation progresses, our methods should progress *pari passu* in simplicity and efficiency. By simplifying the procedure we extend its horizon.



A B C D E F G H

FIG. 1. Tunneling osteotome.

The tips of the spinous processes, in the cervical region, are bound longitudinally by the ligamentum nuchae. This structure continues over the spinous processes of the thoracic and lumbar regions, as the supraspinous ligament. The broad, flat muscles of the back nearly all have their origin in this structure. In the cervical and upper thoracic regions the serrati superiores, the rhomboidei, and the trapezius arise from a more or less fused aponeurotic sheet, the nuchal fascia. The internal oblique and transversalis muscles of the abdomen, the serrati inferiores and the latissimi dorsi, cover the lower thoracic and lumbar regions with a broad, fibrous expansion, the *lumbodorsal fascia*.

It is to be noted that the fibers of these aponeurotic sheets are arranged *horizontally*, and that the muscle pull, throughout the spine is *away from the median line*, producing a physiological tension of the nuchal and lumbodorsal fascia. Here it would seem the idea of McBurney of splitting the fascial structures in the direction of their fibers, rather than cross-sectioning them, the "gridiron" method, would appear useful. William J. Mayo found the same idea useful, in his operation for umbilical hernia, and took a long step forward.

The adequacy of a graft, placed longitudinally in the spinous processes, has been shown. It appears that the graft should be so placed without dividing the fascia across its fibers. By preserving the fascia intact, a positive support would be secured, and *the back rendered immediately rigid by the action of the graft as a splint.*

In order thus to implant the graft, and secure bony contact, it becomes obvious that one must have access to the subfascial bony processes longitudinally. To secure this a special tool became necessary. The tunneling osteotome (Fig. 1) was devised, with a sharp chisel edge, a blade of adequate length and breadth, channeled on its ventral surface, presenting an inclined plane on its dorsal surface, with lateral walls of adequate height. It is bent like a trowel to admit of the blade's being brought parallel with the spinal cord. The reverse curve in the handle gives positive control and freedom from skin contact with the hand. The blade has been bent anteriorly and posteriorly to meet the varying requirements of kyphosis and lordosis.

The patient is placed prone upon the supporting apparatus (Fig. 2A) consisting

* Submitted for publication January 19, 1931.

of head and shoulder rests and pelvic support, so constructed that it can be adjusted to any patient and secure support at any point desirable. Here he rests comfortably with free thoracic and abdominal breathing (Fig. 2B).

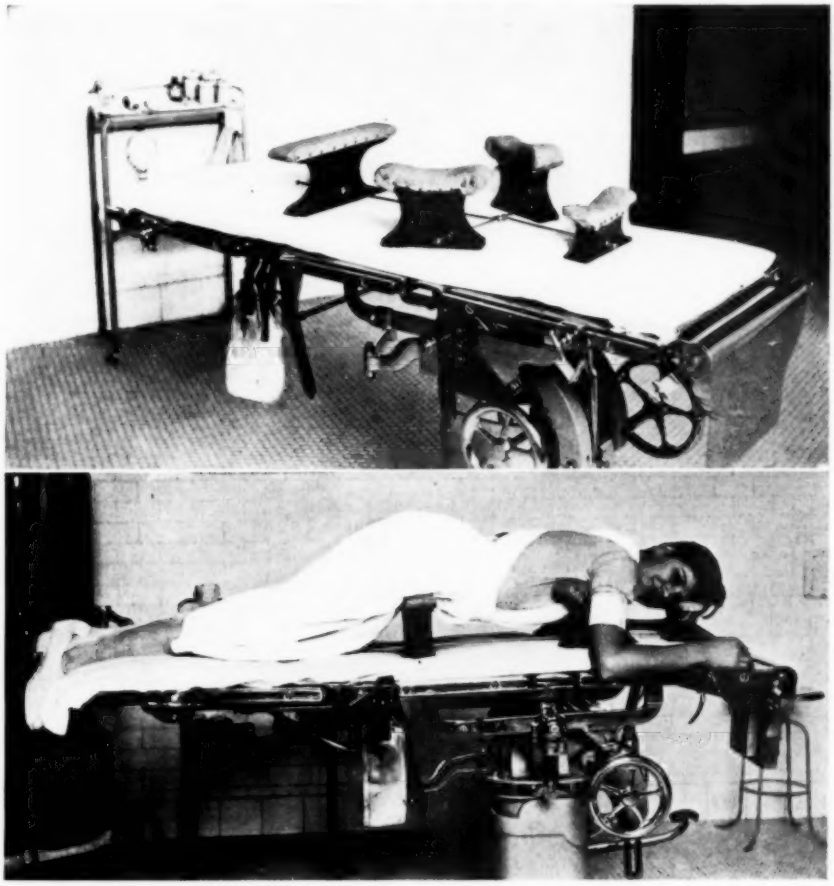


Fig. 2A.

Fig. 2B.

Fig. 2A. Supporting apparatus.
Fig. 2B. Manner of use; note free chest and abdomen, securing full thoracic and abdominal breathing.

A transverse incision, 1½ to 2 in. in length, caudad to the second spinous process below the affected vertebra, through skin, subcutaneous tissue, fascia (in the direction of its fibers), and supraspinous ligament, gives ready access. The tunneling osteotome is introduced, through this incision, to the selected point on the caudad aspect of the spinous process. The process is nicked; the instrument brought parallel with the cord. A sharp tap of the hammer sections the process at this level. Advancing by the sense of touch, the correct level in the next process is selected. A sharp tap of the hammer sections this process. This procedure is continued until five or more processes are thus prepared. The blade of the chisel is now buried in its full length, *subfascially*.

The lateral walls of the osteotome have acted to elevate the tips of the sectioned processes on the dorsal surface of the instrument. A tunnel has been produced, into which a graft, full width of the groove in the osteotome, may be inserted without difficulty. For the purpose of simplifying this introduction, a flanged retractor (Fig. 1A and B) has been devised, with adequate hooks on the ventral surface, so placed as to retract the margin of the skinwound well away from the entrance to the tunnel, with sidewalls of sufficient height to form an adequate channel into which the graft may be dropped. The metal channel so

constructed engages the heel of the osteotome (Fig. 3), protects the graft from skin contact, and gives direction to the graft in its advancement. When properly engaged with the heel of the osteotome, it permits of the graft's being advanced into the tunnel without obstruction.

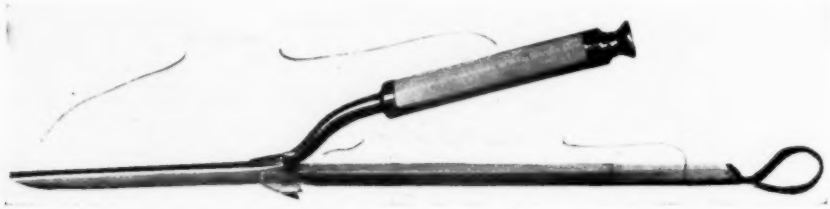


Fig. 3. Channel retractor, engaging heel of osteotome.

The retractor is removed, the osteotome withdrawn, leaving the graft securely placed upon the stumps of the sectioned processes. The *fascial retraction* forces the distal fragments of the sectioned processes down upon the dorsal aspect of the graft, and the graft upon the stumps of the sectioned processes. Thus are produced two points of bony contact: the stump, ventrally, and the distal fragment, dorsally, at each vertebra throughout the length of the implanted graft. No limiting membrane is permitted to intervene at our points of contact.

The slit in the fascia and the supraspinous ligament are whipped together by a running suture of 000 catgut, and the

Fig. 4. Extreme kyphosis requiring a rib. (In this case posterior parts of two vertebrae, including pedicle, with articular and lateral processes, laminae and spinous processes, were completely removed. This permitted a fair degree of straightening. A cast was used. Three months after operation patient started to go to school and continued well, walking over 1¼ miles in all weather. She is still well and strong.)

Fig. 5 A. Fig. 5 B.

Fig. 5 A. Type of case in which a rib would better meet the requirements. A straight graft was used, but a rib would be better.

Fig. 5 B. Same case after operation.

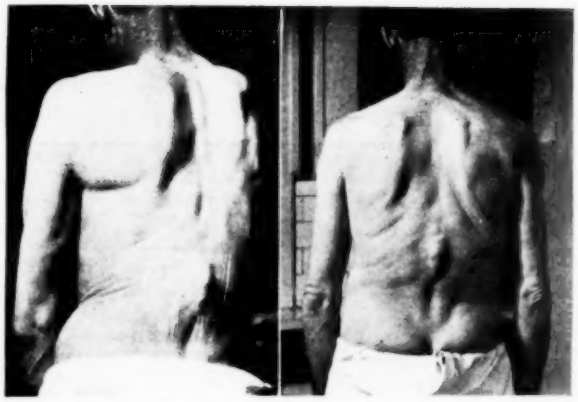


FIG. 6 A. FIG. 6 B.

FIG. 6A. G. I. M. Typical tuberculous spondylitis, bodies of two vertebrae gone, patient helpless. Straight tibial graft, 5½ in. long, ½ in. wide, full thickness of cortex used. Patient up and about without brace or cast in six weeks.

FIG. 6B. G. I. M., after operation. Patient has remained comfortable as far as back is concerned, he is now giving evidence of a tuberculous psoas abscess, pointing on inner aspect of upper thigh, which is giving some trouble. He has been active and strong and gained 40 lb. in weight.

FIG. 6C. G. I. M., after operation; note high point.

FIG. 6D. G. I. M., lateral skiagraph before operation.

FIG. 6E. G. I. M., skiagraph after operation, illustrating presence of graft.

suture is returned, subcutaneously, for the approximation of the skin. This completes the operation. The time necessary for its performance has been from seven to ten minutes.

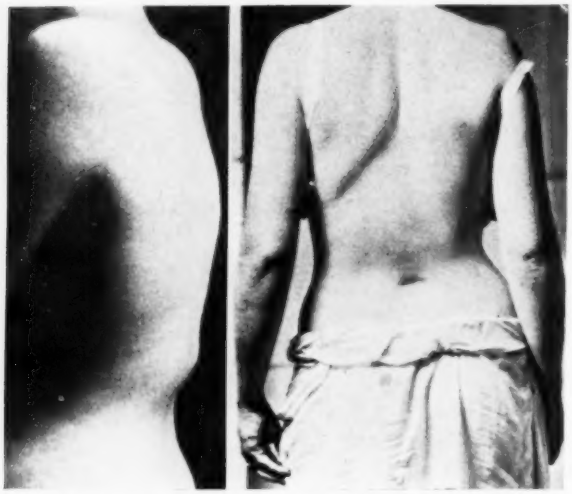


Fig. 7 A. Fig. 7 B.

Fig. 7A. D. M. Kümmell's fracture. This case was reported in *Bone & Joint Surg.*, Oct., 1927. It is included in this report because of its uniqueness in disregard of all orders, and warnings. It has served to give confidence in the security of the method. It proved that what has been regarded as a major procedure is really a simple minor affair. See Case 1. Fig. 7B. D. M. After operation.

The operation as described applies only to those cases in which a straight graft can be used. It has been found that in cases of extreme kyphosis, as illustrated in Figures 4, 5A and 5B, that a curved bone is needed. Here a rib, full width and thickness, of adequate length, being flexible, adjusts itself admirably to the requirements.

For the introduction of the curved rib, the tunnel cannot be made easily and safely from the second vertebra below, to the second vertebra above the affected vertebra; so it becomes necessary to find a different method of approach for these cases. An instrument with the proper curve is selected. The incision is made, as before, *in the direction of the fibers of the lumbodorsal fascia*, and of the same dimensions, caudad to the spinous process of the *affected vertebra*. This spinous process is removed with a rongeur from lamina to tip, leaving a very small distal segment of bone. From this point two processes are sectioned with the osteotome, above the affected vertebra. Our instrument is reversed and the skin is retracted as before. The processes of two vertebrae are sectioned below the affected vertebra. The end of the rib is introduced into the tunnel created by the osteotome. It is twisted slightly to one side, and pushed downward between the fascia and lumbar or dorsal muscles, as the case may be, until the entire graft is buried. The proximal extremity is now introduced into the osteotome, which has been reinserted into the upper tunnel (as a grooved director, ventral surface down), for the accurate emplacement of the upper end of the graft. This takes no time and is easy of accomplishment. The graft is adjusted to its proper position in the act of inserting the upper portion in line, upon the stumps of the sectioned processes. The wound is closed as before.

Fig. 7C. D. M. On the seventeenth day following operation.

The spinous process of the affected vertebra, if left full length, would still

present a high point, posteriorly to our graft (Fig. 6c). When the high point is objectionable it may be resected, leaving a small tip of the distal fragment to be pulled into contact, and no sharp elevation remains.

Fig. 7d. D. M. Playing with her two-year old child, six weeks after operation. She has never worn a brace or cast, and has remained strong and well to date.

You will observe that, whether straight or curved, the graft is applied with a broad, flat surface to the stumps of the sectioned processes. There has been no desire to introduce a graft of these dimensions on edge; in fact it would be undesirable.

That good bony contact is secured is proved by the fact that these grafts remain visible in the *x*-ray from eight to ten years following operation (Fig. 8). They are not absorbed.

The immediate comfort of the patient, following operation, is surprising, and has been attested to by many patients (Figs. 7a–f). Many of the children so treated, are not aware that their backs have been invaded. They know about their shins. They can see the dressings. Even these wounds cause no pain, when the dressings are applied in such a manner, with longitudinal strips of adhesive, to the anterior surface of the leg, as not to permit a drag on the dressings in bed.

Fig. 7e. D. M. a-p skiagraph four years after operation showing graft.

The postoperative care is most simple. No retentive dressing is applied, no cast, no brace. The patient is permitted to lie on his back on a flat bed. Movements in bed, in the horizontal position, are permitted *as early and as freely, as the patient desires.* The reason for this is that a long graft, planted longitudinally, *under the uncut fascia*, is held rigidly in place by this structure, and is, thus, itself the supporting agent upon which we depend. The fixation of the spine by a support so inserted is immediate and complete. The position of the graft is secure, as is shown by a number of cases in which early movements of the most extreme type failed to dislodge the graft and caused no trouble whatever. A wooden peg, so placed, would give the same relief from pain, but the autogenous

graft of living bone will, in time, fuse with the fragments of the sectioned spinous processes in such a way as to give a

Fig. 7f. D. M. Lateral skiagraph four years after operation showing graft.

permanent, rigid support where most needed.

Osteogenesis is known to be slower in the region of the spinous processes than in the long bones. The implantation of a long-bone graft into the field stimulates bone growth.

The reparative process by which a tuberculous spine is cured is necessarily slow, and it may be true that the complete cure of the condition requires long lapses of time. But the relief from pain, and the freeing of the patients from long periods of invalidism render it possible for them to get out and play in the sun, the best cure. I have endeavored to keep my patients from sitting or standing until the graft should be fixed by the formation of a good, strong callus; that is, from four to six weeks, but I have failed to secure such conduct in a few cases, with such results as to give me more and more confidence in the safety of a wider range of freedom.

The advantages of this method of implantation, as compared with recognized procedures are: its simplicity, facility of performance, freedom from unsightly scars, small amount of exposure incident to the

Fig. 8. G. K., aged twenty-four. Sacralization fifth lumbar vertebra. "Batwing" right lateral process, fused with sacrum and ilium; fracture of right lateral process. See Case 11.

small incision, lessening trauma to the essential structures, freedom from introduction of sutures or ligatures for the retention of the graft *in situ*, freedom from surgical shock, immediate fixation of the painfully mobile spine, freedom from the necessity of postoperative braces or casts, and early return to normal activity.

The development of this method in the course of a fairly busy surgical practice in the country, might be of interest.

In attempting to do an Albee operation on a boy with a decided kyphosis (Fig. 10 A–C) I was embarrassed, on exposure of the field, by the length of the graft required, and by the fact that I could not succeed in fastening the ends of my graft down to the bone where I felt it necessary to secure bony contact in the entirety of my graft. Lacing it down with kangaroo tendon did not seem quite adequate. It dawned on me that if I could hang the ends under the uncut fascia at the upper and lower extremities of my long back

incision, I would get better approximation of the graft to my split spinous processes.

I secured a graft from the tibia a bit longer than was required to reach the affected vertebrae which I desired to include in the fusion, and in order to get a full effect of the straightening of the back I inserted the lower end under the uncut fascia, pushing it down until the upper end could be similarly engaged under the uncut fascia at the upper extremity of the incision. When I succeeded in getting the ends tied down under the uncut fascia, I had produced a gentle curve in the graft, and the graft itself acted as a long spring for the correction in a very pronounced manner of the kyphosis.

I was surprised at the intimate application thus secured of the graft to the mutilated spinous processes without a suture. The sutures were introduced however, giving added security to the emplacement of the graft, and the wound closed.

The boy made an uneventful recovery. The graft stayed put. I had succeeded in getting enough straightening of his back to add 2½ in. to his height, and had put the abdominal muscles, which were greatly shortened in the position of gibbus, upon the stretch until he roared with pain at the tension. This was the only pain he had and was gradually relieved as the abdominal structures and the overhanging thorax adjusted themselves to the upright posture. The photographs (Figs. 10, A–C) illustrate this case. The lateral skiagraph is not available. The young man is a telegrapher and is today, after fifteen years, sound and well.

The operation has been performed in approximately 100 cases, indiscriminately, without attempting to make a record for the procedure.

The only fatalities which might be traceable to the procedure, have been 3 cases which never should have been included in the series. One was a child of two years of age, so anemic that it died under the anesthetic before an incision was made. My experience prompted me to attempt to alleviate this child's pain.

The second was an old man who died shortly after the operation from nephritis.

The third was a child who died shortly after the operation from miliary tuberculosis. If I had been attempting to protect the procedure from adverse criticism these cases would not have been touched.

Fig. 9. A. L. D., aged twenty-five, showing the use of a rib in the lumbar region.

The remainder of the series have, without exception, presented a successful issue. Uniformly pain has been relieved, fixation been secure, and so far as a mechanical fixation can be successful have resulted in cures.

CASE REPORTS

Case 1 (Fig. 7).[1] Patient aged 20, seen on April 2, 1927. Inspection showed kyphosis in the lumbar region. She was run over by an automobile one year before and "jack-knifed" to such an extent that both hips were dislocated, and her back broken at the third lumbar vertebra. She was carried home, the dislocated hips reduced, but the back was overlooked. She was kept in bed for four weeks. Immediately upon assuming the upright posture, the kyphosis became manifest. It had become more pronounced, giving her daily pain to such an extent as to incapacitate her. Skiagraphs one

[1] *Bone & Joint Surg., Oct., 1927.*

year after the injury, showed typical Kümmell's fracture of the third lumbar vertebra, fracture of left lateral process of third lumbar vertebra.

the ward where she was to be placed, she climbed out of the wheelchair unaided, walked over to the bed and retired.

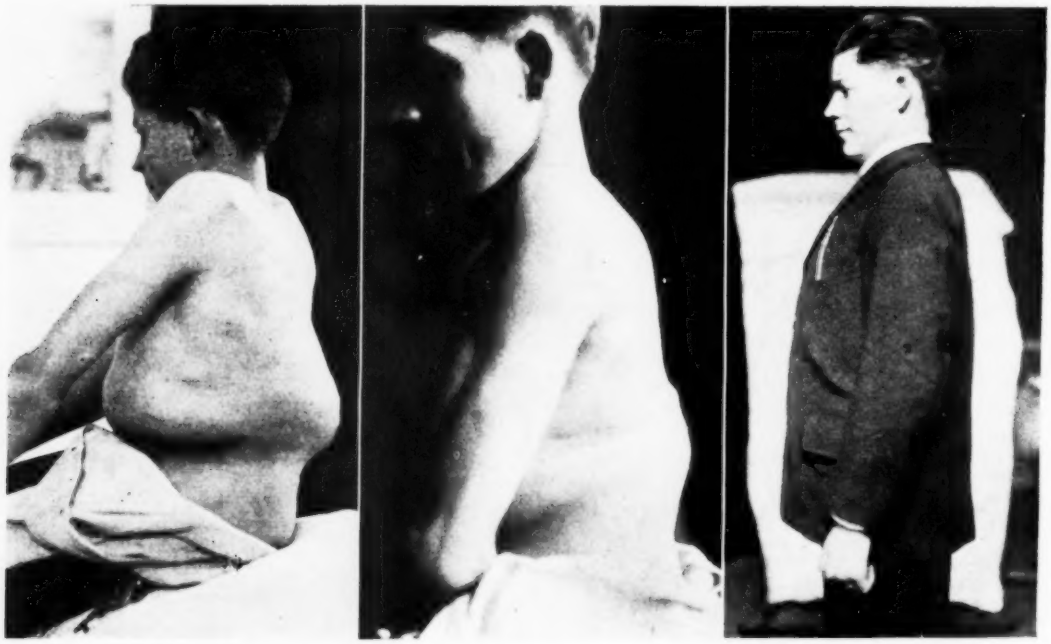


Fig. 10 A. Fig. 10 B. Fig. 10 C.

Fig. 10A. E. M. Pronounced kyphosis, Kümmell's disease.
Fig. 10B. E. M. After operation.
Fig. 10C. E. M. After operation.

Fixation was advised and operation performed April 8, 1927. A straight tunnel was driven from the fifth to the first lumbar vertebra, sectioning the posterior processes subfascially at a safe level from the spinal cord. A 1 in. incision was used for entering the osteotome. A 5½ in. graft, ⅜ in. wide, full thickness of the cortex of the tibia, bare of periosteum, was secured and inserted into the tunnel. The tunneling osteotome was withdrawn; wounds were closed with 000 catgut, simple dressings were applied and patient was put to bed on a flat mattress, on her back. Operation required thirteen minutes.

The postoperative treatment of this case and the patient's rapid recovery read like a combination of Baron Munchausen and the Arabian Nights.

On the third day following the operation, feeling so inclined, the patient arose and used a vessel at the side of the bed, sitting in the upright posture. She has never used a bedpan. At the end of a week she got up and walked, climbing into a wheelchair unaided, to be transferred to another floor. On arrival at

Two weeks following the operation she walked out of the hospital and rode home in a Ford. On the sixteenth postoperative day she took a joy-ride to a neighboring town in a Ford, *driving the car herself.*

On the seventeenth day she came to the writer's office, spent the afternoon pleasantly conversing and walking about the place; took supper with him and went with him to the meeting of the Jasper County Medical Society, where her case was presented at the clinic. In order to get to the room in which the society met, she walked up the flights of steps at the approach of the building, and up a long flight of stairs to the second floor, unaided.

The only discomfort she felt was a slight stiffness of the scar on the shin from which the bone had been removed. Her back was free from pain; she looked and acted as though she had nothing the matter with her back; she stooped and picked up a knife from the floor as easily and comfortably as if she had never sustained an injury. In the fourth week following her operation the patient attended a carnival being held in town. Upon entering a dark room

and sitting down on a bench, the bench was suddenly jerked out from under her and she was precipitated unexpectedly down a long incline, arriving at the bottom with a bump. She rode the merry-go-round, indulged in all the trick performances, and as a climax to her effort, apparently determined to break her back, rode what she called the "Whip" five times in succession. After these strenuous trials she is convinced that her back is strong.

Case II (Fig. 8). Low back injury caused by horse falling on patient while in service during the war. Patient came to my office walking with great difficulty, dragging one leg with a painful sciatica. A brace which had been applied two years previously had benefited him, but had not cured him. The skiagraph showed a "batwing" right lateral process of the fifth lumbar vertebra which had been fused with the sacrum and ilium, but which in his accident had been torn loose from its moorings to the ilium, producing a painful situation. Fusion was recommended, and accepted in the hope of relief. Operation, June 1920: with a straight ½ in. carpenter's chisel, tunneling from well down on the sacrum under the fascia, lifting bone with the fascia, upward through the spinous processes of the fourth and fifth lumbar vertebrae; a graft ½ in. wide, 4 in. long, full thickness of the cortex, was secured from the tibia, and inserted in the tunnel. The patient was put to bed on a flat mattress without supporting apparatus. He sat up on the side of the bed in fourteen days, his pain decidedly relieved; was up and about in four weeks, and left the hospital in six weeks. The irritation of the sciatic nerve continued slightly to embarrass him for several weeks, but gradually disappeared entirely. The skiagraph (Fig. 8) illustrates the presence of the graft eight and one-half years after operation. The year following the operation the young man took a course in geology at the Missouri School of Mines. During the course he went on field trips with the other students, and has continued active in geology. This case illustrates the use of the straight graft in the lumbar region. Complete cure.

Case III (Fig. 9). Osteoarthritis of the second and third lumbar vertebrae; painful back rendering patient helpless. Operation, Feb. 1925: A section of the right tenth rib, 4½ in. long, entire rib, inserted in the tunnel extending from the third to the fifth lumbar vertebra, fixing the affected joint. A curved osteotome (Fig. 1, E) was used to drive the tunnel. The patient was up and about in four weeks, and left the hospital in six weeks; has been earning a living at hard labor to date. Complete recovery.

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* Continued from p. 447.

OBSERVATIONS ON
INGUINAL HERNIA*

C. F. Thompson, M.D., and Jewett V. Reed, M.D.

INDIANAPOLIS, INDIANA

EVER since the establishment of the Workmen's Compensation Laws the question of whether or not a hernia is the result of a specific injury has been the subject of a great deal of discussion both by the legal and the medical professions. One of the commonest questions that we are asked to decide is whether a hernia is spontaneous or due to trauma, and whether it is recent or old. After some experience with this type of abnormality we have arrived at certain conclusions which in our opinion is very definite.

As we know, inguinal herniae are divided into the direct and indirect types. The direct, in which the protrusion presents at the triangle of Hesselbach, mesial to the deep epigastric artery, is a very rare type, difficult to repair, and we have never seen a case of this form in which there was a claim of a traumatic etiology.

The indirect inguinal herniae protrude through the internal inguinal ring, external to the deep epigastric artery and are of two types, the incomplete and complete. The incomplete type is often erroneously called direct because the protrusion is directly forward instead of extending down the inguinal canal. In some cases the incomplete type is an early stage of the complete inguinal hernia, but most often the incomplete type remains such without extending into the canal or scrotum.

In the complete type of indirect inguinal hernia the sac presents at the external inguinal ring and progresses downward into the scrotum. This type is by far the most common form of hernia and is most frequently the subject of legal controversy.

About ten years ago we conceived the idea that the term "rupture" was a misnomer, and that an indirect inguinal hernia extending down the canal was due entirely to the dilatation of a preexisting patent funicular process. Since then, to the present we have never seen a case of recent hernia that showed features to disprove that idea. In normal males, about the time of birth, the funicular process becomes obliterated. In a few cases this process remains entirely open forming a communication between the peritoneal cavity and the space of the tunica vaginalis, and leads to the formation of the type of so-called congenital hernia. This generally manifests itself during infancy. A more common occurrence is the closure of the testicular end of the process with the peritoneal end remaining open. In such a case this patent funicular process forms a narrow peritoneal sac communicating with the peritoneal cavity. In some cases this process is obliterated in its lower portion, but in most instances it exists as far as the upper pole of the testicle. Given such a condition it is easy to see how repeated or constant strains that increase intra-abdominal pressure would gradually stretch the peritoneal opening of the funicular process. The pressure of the gut, or more commonly the omentum, after dilating the upper opening, can easily distend the remaining portion of the process as its walls become thinner as they extend downward.

It is our belief that all cases of complete indirect inguinal hernia are formed in this manner. In a few cases we believe that we have observed the funicular process return to its prehernial size. This has been seen in patients on whom we have demonstrated a definite sac, but on account of some temporary contraindication to operation we have put them to rest for one to two weeks. At the end of this time no sac could be demonstrated, but the patient

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was operated on and in each one a narrow patent funicular process was found showing that the dilatation had not become permanent and with the removal of increased intra-abdominal pressure the sac had returned to its former diameter. In quite a few cases the funicular process had not become entirely dilated at the time of operation and it could be demonstrated as a fine tube continuous with the lower portion of the sac.

In several instances, a patient with a complete inguinal hernia on one side only, has given the history that at times a swelling has appeared on the opposite side for a short time and then disappeared. Examination of this side revealed no palpable sac. At the time of operation of the apparent hernia, the opposite side was explored, and in each instance an open funicular process was found.

In almost every case of recent hernia, in which the sac has not had time to become thickened by irritation, on opening the sac, one finds at the upper part of the neck a ring or band of subperitoneal connective tissue. In some cases this thickening is barely perceptible, in others it is present as a definite band, and rarely as a partial but definite diaphragm. This thickening represents the level at which nature should have obliterated the upper end of the funicular process. To find this band or zone of thickened tissue in the neck of the sac is most important in the cure of the hernia. We believe that every case of recurrence that we have had has been due to the ligation of the neck of the sac below this line, in which case we left a portion of the upper funicular process to serve as funnel for the starting point of a new sac.

Moreover, we also believe that if the neck of the sac is ligated at this thickened portion, where nature should have closed it, that the hernia will be cured, and that the transplantation of the cord and other elaborate methods of closure are entirely superfluous. After removing the sac, we simply bring the edge of the internal oblique muscle to Poupart's ligament with three or four sutures, and then close the defect of the aponeurosis of the external oblique muscle and skin.

As mentioned before, the formation of spontaneous scrotal hernia is due to constant or repeated strains gradually distending the patent funicular process. In traumatic scrotal or complete indirect inguinal hernia the distension is caused by a single strain. The condition is one of aggravation of a preexisting congenital abnormality. The only difference between the spontaneous and the traumatic type is that the former is gradual, the latter sudden. From a clinical standpoint there is one marked difference between the two types. In the spontaneous type the stretching of the funicular process is slow and gradual and the patient suffers little if any pain or discomfort. He often does not know that he has a hernia until he accidently discovers the swelling. In the traumatic type, on the other hand, the sudden stretching of the upper opening of the funicular process always causes sudden and disabling pain. In most cases this is accompanied by nausea and vomiting. It is the general experience that in operating under local anesthesia, pulling or stretching of the parietal peritoneum causes patients to complain of pain, and they are also frequently nauseated. It is inconceivable that the sudden stretching of the peritoneum at the neck of the sac, in a person without a local anesthetic, would not cause him to suffer the same symptoms. In fact, in every case of traumatic hernia of this type the patient gives a definite history of immediate disabling pain, frequently accompanied by nausea and more or less shock. The protrusion of the sac through the external ring may not appear before twelve to twenty-four hours. Tenderness about the inguinal region is immediate and may last for several days. We have never seen extravasation of blood or ecchymoses unless the injury was in the form of a direct blow over the inguinal region.

Occasionally the patient gives the history

that after the initial pain he sits or lies down for an hour or two, after which he feels better and resumes his work. This is not incompatible with a traumatic hernia. But when a patient claims that his hernia is due to a specific trauma and does not give the history of an immediate disabling pain, he is either grossly mistaken or is not telling the truth.

We are often asked to try to determine the duration of a hernia by the size of the sac. In a patient with a thick scrotal sac the size of an orange who claims that it is due to an injury of a few days before, we know that there is a mistake somewhere, but in the majority of thin-walled sacs it is impossible to arrive at any conclusion as to their duration. The reason is that the size of a recent hernia depends largely upon the length of the open funicular process. A spontaneous hernia of a year's duration may extend only ½ in. beyond the external ring because the funicular process was only open a short distance. Again, a traumatic hernia may fill a sac extending to the upper pole of the testicle within twenty-four hours after the injury. So we feel that in a thin-walled sac it is impossible to determine the duration of the hernia by its size.

Many consider the size of the external inguinal ring as an important factor in the causation of indirect inguinal hernia. It is true that in very large or old herniae the ring becomes enlarged, but in the smaller or recent cases our experience shows that there are no more cases with the large rings than with the small. Again we see men who do the heaviest form of manual work, who have very large rings with no signs of hernia.

An interesting observation was made on naval recruits during the late war. One of us examined and accepted several thousand men. A record was kept of the physical findings on each man which included the size of his external inguinal rings. It is an unpleasant custom in the Navy that when an enlisted man develops an abnormality a few months after his enlistment, the examining surgeon is sent a very disagreeable letter asking why he accepted a man with such a defect. Quite a few such letters were sent back concerning men who had developed herniae and in searching for an alibi in the record of the size of their rings in a very few instances did the record show enlarged inguinal rings in those men who had developed herniae.

While it is very difficult or even impossible to determine the duration of a hernia with a thin-walled sac by physical examination, this point may be easy to determine at the time of operation. It is not known how long it takes for the formation of dense peritoneal adhesions, but it probably takes at least sixty days. If on opening the sac one finds its walls thickened, if there are bands of connective tissue in the walls of the sac, or if there are firm adhesions between portions of intestine or omentum to the wall of the sac, we can safely conclude that the hernia is at least two months old and probably older. Diverticula of the sac or a sac with multiple compartments are an indication that the hernia is many months old.

The presence of an elongated lipoma in the inguinal canal in a patient with hernia has been interpreted in various ways. Some hold that the presence of lipoma predisposes to hernia. Others believe that the presence of the lipoma is an indication that the hernia is of long standing. We do not hold to either of these views, but believe that this elongated mass of fat is an attempt on the part of Nature to support the open funicular process, an attempt at repair of Nature's failure to complete a developmental process. We consider it a process similar to the so-called lipoma or fat pad found in patients with spina bifida occulta.

In the case of incomplete indirect inguinal hernia, that type in which the sac does not present at the external ring, we have two forms. The first is identical with the complete form except that the open funicular process is very short, or

that the process is very narrow and enough time has not elapsed to fully dilate the process. In this type of case the swelling is just above the external ring and if due to an open funicular process will gradually progress downward.

The second type of the incomplete indirect inguinal hernia (often erroneously called direct) has no open funicular process. The sac is simply a bulging of the peritoneum through the internal ring. Before this bulging can take place there must be a separation or splitting of the fibers of the external oblique aponeurosis. This may occur as a spontaneous process in thin and poorly developed individuals, but these patients rarely complain of pain or discomfort. When this same type occurs as the result of a sudden strain there is the sudden disabling pain, nausea and local tenderness. As a rule these symptoms are more marked than in the case of stretching the mouth of the funicular process. Operation is seldom indicated as in our experience the patient recovers completely within one to three weeks of complete rest, during which time the tear in the aponeurosis heals and the bulging peritoneum shrinks back to normal. Occasionally, spontaneous healing fails to take place and an operative repair must be done. No sac is found, but the bulging peritoneum should be opened, overlapped and sutured.

CONCLUSIONS

Traumatic inguinal herniae occur as complete and incomplete indirect herniae.

Complete indirect inguinal hernia whether spontaneous or traumatic, is in our opinion the result of the dilatation of a preexisting funicular process.

Incomplete indirect inguinal hernia is either the early stage of the complete type or it is the bulging of the normal peritoneum following a giving away of the fibers of the aponeurosis of the external oblique.

In all types of traumatic herniae the sudden stretching of the peritoneum causes immediate disabling pain often accompanied by nausea. If these symptoms are lacking, the hernia is not the result of a single strain.

In herniae with thin-walled sacs it is impossible to determine the age of the hernia by the size of the sac.

ABNORMALITIES IN THE SHAPE AND POSITION OF THE DUODENUM*

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CASE REPORT

CASE I, C. G. male, aged thirty-six.

Past History. In 1922, operation for perforated duodenal ulcer: suture and drainage: uneventful recovery.

Present Illness. For six weeks has complained of cramp-like pains in the epigastrium, followed by vomiting of food after every meal; on one occasion the vomitus was coffee-ground in character. Has lost weight and is constipated.

Physical Examination: A slender, nervous individual. There was slight rigidity of the upper right rectus muscle, stomach extended from fifth rib to navel.

Test Meal: Free hydrochloric acid in excess.

Braid Test: Slight blood stain obtained from the duodenal area just beyond the pylorus.

X-ray Examination: A niche in the pyloric region: moderate six-hour gastric delay.

Diagnosis: Duodenal ulcer with partial pyloric obstruction.

Operation, Nov. 28, 1928.

Pathology: Indurated pylorus did not admit the tip of finger. Ulcer upon anterior surface of duodenum close to the pylorus. The first portion of the duodenum was adherent to the liver: the first and second portions were dilated. The inferior duodenal angle bulged prominently through the posterior peritoneum, close to the hepatic flexure of the colon and the third portion extended to the left towards the mesenteric root.

The jejunum did not present in the usual position at the left of the spine, but entered the peritoneal cavity through a firm arched opening in the mesentery of the ileum close to the ileocecal region.

It did not ascend to the under surface of the transverse mesocolon but passed to the left in the lower abdomen.

The duodenum was constricted at the point where it passed through the mesentery and dilated above.

Traced backwards, it extended obliquely upward below the mesenteric root and turned to the right to form the inferior duodenal angle.

Procedure: Pylorectomy: end-to-end anastomosis (Billroth 1): opening in the mesentery enlarged.

Result: Satisfactory convalescence, remains free from symptoms.

CASE II, male, aged eighteen.

Past History does not apply.

Present Illness: one day before admission to Gouverneur Hospital, vomited and complained of pain in the lower left quadrant. Upon his admission, there was rigidity of lower left rectus muscle, leucocytosis and slight temperature.

Diagnosis made of acute diverticulitis.

At operation the cecum and appendix presented in the left iliac fossa.

The acutely inflamed appendix was removed and convalescence was uneventful.

It was recognized that this was probably a case of non-rotation of the colon and before leaving the hospital a barium enema was given the patient which confirmed this opinion. It was further suggested that the duodenum had also failed to rotate as is usually the case with non-rotation of the colon. To determine this, a duodenal tube was introduced, its position in the duodenum confirmed by *x*-ray, and a barium emulsion was injected through the tube. The picture showed the barium extending downward to the right and not crossing the spine. It was therefore concluded that the duodenum had not undergone rotation.

COMMENTS

The first case is of surgical interest because it was intended to do a gastro-enterostomy. When the duodenojejunal angle was looked for in its usual location, it could not be found. It was then sought for at the right of the spine but as it did not present at this point, a systematic search was made, commencing at the ileocecal junction and inspecting all the loops of the

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small intestines until the opening in the mesentery was reached close to the starting point.

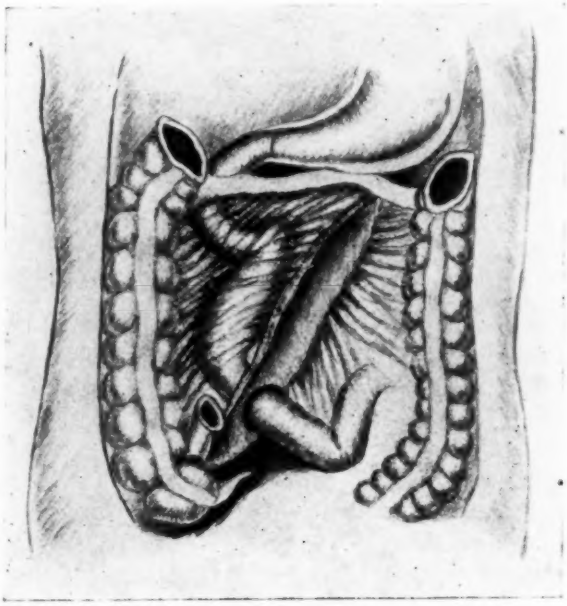

Fig. 1. Abnormal position of duodenum. Transverse colon, jejunum and ileum removed. Third portion of duodenum passes to left to vicinity of mesenteric root and then turns downward, entering abdomen through a constricted ring in mesentery close to ileocecal junction. Duodenum is dilated immediately above this point. Personal observation.

The dilatation of the duodenum above the mesenteric opening caused some doubt as to the adequacy of the Billroth I operation, but it seemed the only method available and the plastic operation upon the mesenteric opening has apparently allowed satisfactory duodenal drainage.

This particular anomaly does not appear to have been previously described but has probably been recognized, as one writer refers to a duodenum entering the abdomen to the left of the cecum.

The case of non-rotation of the duodenum accompanying non-rotation of the colon, was in this instance of anatomical interest only, but that it may complicate surgical procedures, is shown by a case, described by Mumford, in which the duodenojejunal junction was at the right of the vertebral column. A short loop posterior gastroenterostomy, for pyloric obstruction, terminated fatally, and autopsy showed that, as the stomach contracted, it had torn loose from the anastomosis resulting in peritonitis.

Fig. 2. Non-rotation of colon. Left-sided appendicitis after operation. Personal observation.

GENERAL CONSIDERATION

Study of the literature reveals a number of anomalies in the shape and position of the duodenum. Some of them are congenital and others are dependent upon variations in the length and fixation of the duodenum, and the shape of the abdomen, or are secondary to changes in the stomach, gall bladder, pancreas, liver, colon and right kidney.

Among the more frequent variations are the following:

Non-rotation: Non-rotation of the duodenum regularly accompanies non-rotation of the colon and may occur independently.

The duodenojejunal angle is then at the right of the vertebral column and the duodenum is not crossed by the mesenteric root.

In the simplest form, the third and fourth portions are lacking, the first and second portions curve convexly to the right and

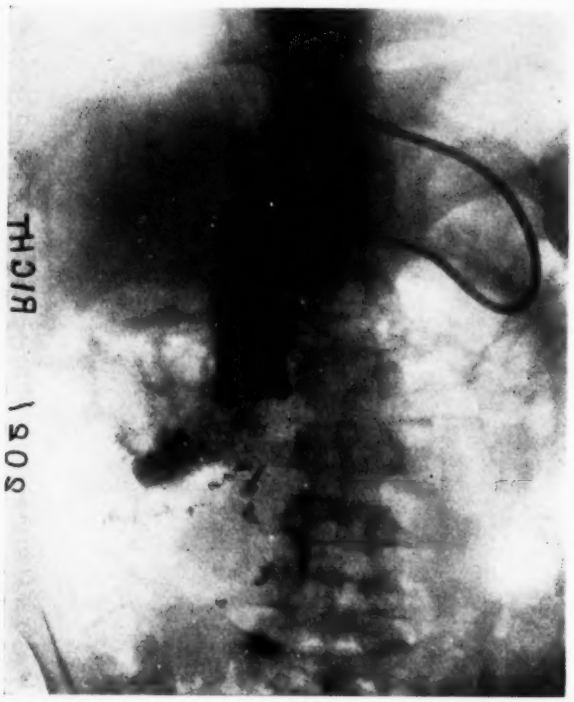

Fig. 3. Non-rotation of duodenum accompanying non-rotation of colon. Tube has been introduced into duodenum and barium injected through tube is distributed to right of vertebral column. It is the rule for the duodenum to enter abdomen without crossing the spine if colon has not rotated. Personal observation.

become intraperitoneal below the hepatic flexure of the colon.

Duodenum Mobile: In this condition the fetal mesentery perists so that the duodenum is mobile. It has been associated with non-rotation of the duodenum.

The condition was described by Roud in 1898 but the name was applied by Miyaki in 1916.

Duodenal Ptosis (Chilaiditi, 1911): The following forms have been described:

A. The first portion is elongated, the superior angle is fixed and is more acute than normal, so that motility is interfered with. It is usually secondary to gastroptosis, which causes a constant drag upon the superior angle.

B. The first portion and the superior angle are normal but the second and third portions are elongated and the inferior angle is prolapsed. This is usually found in individuals with a contracted abdomen but is probably favored by abnormal

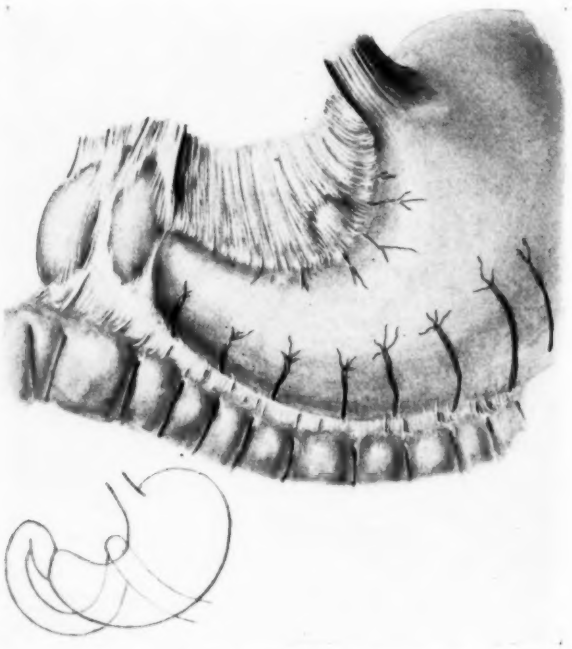

Fig. 4. The duodenojejunal angle appearing above lesser curvature of stomach, sometimes giving an *x*-ray picture suggestive of diverticulum or ulcer niche.

length of the duodenum, and ptosis of the right kidney and hepatic flexure of the colon.

C. The superior angle prolapses, the first portion is displaced in front of the second and third portions. This is favored by laxity of the hepatoduodenal ligament.

D. The entire duodenum prolapses as far as the mesenteric root or the duodenojejunal angle.

E. At rare times the duodenojejunal angle yields and total ptosis occurs.

This form is associated with marked mobility of the pancreas.

Busi's Kink: A kink in the second portion was described by Busi in 1912.

It is attributed to elongation and ptosis of the second portion with fixation at the ampulla of Vater due to traction by the unyielding hepatic and pancreatic ducts.

The chief interest lies in the roentgenographic interpretation.

Expansion of the Duodenal Curve: Pathologically this occurs with pancre-

atitis, cysts and lesions of the retroperitoneal lymph nodes.

It is not unusual however, to observe a wide curve in large individuals with a broad subcostal arch, in whom the duodenum is elongated without other pathology.

Its roentgengraphic recognition may be of value in differentiating tumors in the region of the head of the pancreas from other upper abdominal lesions.

Changes in Shape: The duodenum may be triangular or describe a complete circle, the duodenojejunal angle being approximated to the pylorus.

An elongated segment may assume a serpentine or s shape, turned on its side and curving in front of the left kidney.

The third portion may ascend to the right of the second portion and cross to the left, (a) behind the second portion, the first portion or the pylorus, (b) in front of the second portion.

The third portion may ascend vertically to the left of the second portion but without crossing the vertebral column. In its course it may be retroperitoneal or intraperitoneal.

The duodenum may ascend to the normal position of the duodenojejunal angle and then turn to the right, crossing the abdomen to the right of the mesenteric root.

The duodenojejunal angle may ascend to a point above the lesser curvature of the stomach, giving the appearance roentgenographically of a diverticulum or an ulcer niche.

Symptoms: These anomalies may be of anatomical interest only, or may complicate roentgenographic diagnosis and surgical procedures, particularly gastroenterostomy.

They may moreover give rise to intermittent kinking with pain and obstructive symptoms varying with the relation of the interference to the ampulla of Vater.

Treatment: In many cases treatment is not indicated or relief may be obtained by postural treatment and supporting belts.

In some instances surgery is required.

Ptosis of the first portion may be relieved by gastropexy or duodeno-duodenostomy. A mobile duodenum may be fixed by duodenopexy. A lesion beyond the inferior angle may be treated by duodenojejunostomy.

A NEW TREATMENT OF PEPTIC ULCER

A PRELIMINARY REPORT*

GEORGE P. PITKIN, M.D., F.A.C.S.

HACKENSACK, N. J.

THE purpose of this communication is to make a preliminary report of our results in 127 cases of gastric and duodenal ulcer treated by a new method devised by the author.

The preparation used is a combination of foreign proteins derived from non-pathogenic schizomycetes, reinforced by lipoids and animal fats, with emetine.

We are forced to believe that a large percentage of peptic ulcers can be healed in from six to ten weeks by this agent given intravenously, that in a short time symptoms will disappear and the patient can go on a full unrestricted diet, even including alcoholic beverages with freedom from gastric distress.

We feel justified in our conclusions from the results obtained in a series of 310 cases, 127 treated by the author and the others by co-workers. The latter will report their findings, as soon as each individual series is sufficiently large to allow of definite conclusions.

The cases treated may be classified as follows:

Men 111
Women 16
Acute ulcers of less than six month's duration 9
Of more than six months 118
Gastric ulcers 6 (including 2 penetrating)
Duodenal ulcers 121 (including 2 penetrating)
Ruptured duodenal ulcers 5
Syphilitic ulcer 1 (duodenal)
Duodenal ulcer with chronic appendicitis 5
Duodenal ulcer with gastroptosis 3
Hematemesis 3 (gastric 1, duodenal 2)
Hematemesis after gastroenterostomy 1 (duodenal)
Hemorrhage from bowels 2 (duodenal)
Cases previously treated by duodenal feeding 3
Pain persisting one or more years after the repair of a ruptured duodenal ulcer 3
Pain persisting after gastroenterostomy for ulcer 4
Appendectomies for relief of pain without results 5 (by other surgeons)
Cholecystectomies for pain without results 3 (by other surgeons)
Paraduodenal adhesions for relief of pain without results 1 (by other surgeon)
Results of intravenous medication:
Pain relieved after first injection 76
Pain relieved after second injection 16
Pain relieved after third or fourth injection 20
Pain relieved after five or more injections 6
Acute pain relieved, sensation of heaviness remaining 5
No relief 4

The gastric or duodenal ulcer sufferer is in an unenviable position. The members of the medical and surgical professions will agree that our present-day treatment is not satisfactory. Medicinal therapeutic measures combined with strict diet may and often do relieve pain, and while the stomach contents are alkaline or neutral the patient experiences little discomfort. There undoubtedly is a certain percentage of cures under this regime, the exact number being very difficult to estimate, but in the vast majority of cases, indiscretion in diet or moderate indulgence in alcoholic beverages will invariably bring about a return of symptoms. The patient

* Submitted for publication March 16, 1931.

usually remains a slave to diet and drugs to enjoy even a fair degree of comfort and health.

Innumerable patients after trying out medical measures with no permanent relief turn to surgical intervention hoping for a cure. Should surgery be resorted to, what is to be done, and what are the results? The members of the surgical profession are far from unanimous in their opinions of the proper procedure to follow in order to cure this condition. One group advocates gastroenterostomy, another faction advises gastric resection. Others claim that the only proper procedure is excision of the ulcer. Such diversity of opinion among the very best surgeons is an admission that the surgical treatment of gastric ulcer is far from being satisfactory. If a gastroenterostomy is performed a convalescence of several months may be anticipated. Marginal ulcers may develop necessitating a second operation, or, as so often happens, the patient experiences no relief from his condition. Should resection be resorted to, either a subtotal gastrectomy or a groove resection, the patient may be relieved of pain but he has undergone a severe risk and at best can only hope for a fair measure of relief and may go through life with vague digestive disturbances of more or less severity. When the ulcer is accessible and can be excised the best results undoubtedly follow. But we must not blind ourselves to the surgical dangers. There is always the operative risk and the mortality is to be reckoned with, whether due to the operation itself, the anesthesia, or secondary complications.

It has been said that necessity is the mother of invention. When one has suffered from a duodenal ulcer for twelve years and has found no relief in medication or diet, and, at the same time, fears the results of surgical intervention, he will endeavor to find a treatment devoid of risk that promises a fair degree of success, as far as the permanence of the cure is concerned. Therefore, I feel justified in making this preliminary report of a new therapeutic method for the following reasons: I have secured absolute personal relief from this treatment, and its value has been demonstrated in over 300 additional cases as stated previously; the results being corroborated by the disappearance of symptoms, *x*-ray examination, and gastric analysis.

For years Holler, Pribram, Mueller and Petersen, and others have been working with various proteins to control gastric functions and check the hypermotility of the stomach. They were able to stimulate the vegetative nerves and produce hypoperistalsis, lessen the amount of free hydrochloric acid, induce a hyperemia and increased vascularity about the ulcerated area in the gastric mucosa, as well as augment the production of gastric enzymes and total lipoids. However, they were able to control these physiological functions only for one and one-half to two hours, which is of little therapeutic value in peptic ulcer.

By reinforcing the protein with lipoids and lipins, a more sustained action was obtained. Finally, it was found that emetine acted as a synergist in such a manner that we were able to control the gastric functions for a period from ninety-six to one hundred and twenty hours with one intravenous injection. The combined solution has also a decided cumulative action so that after the fifth or sixth injection, hypoperistalsis, increased vascularity, muscular relaxation, and dilatation of the stomach are maintained for a period of more than two hundred and forty hours. There is also an increased flow of gastric juice containing a relatively low hydrochloric acid percentage and adequate enzymes. These induced phenomena make the patient comfortable, free from pain, and promote healing of the ulcer. The solution also increases the resistance of the tissues about the ulcer and produces an antibacterial action on the causative microorganisms.

In exhaustive experiments Rosenow has demonstrated that peptic ulcers may be

caused by certain groups of streptococci. He was able to produce ulcers in the stomach of animals experimentally by the injection of cultures from the strains obtained from human gastric ulcers.

A therapeutic agent that will render the patient symptom free and induce healing of a gastric or duodenal ulcer must possess the property of regulating physiologic functions as follows:

Stimulation of the vegetative nerves of the splanchnic plexus must be produced sufficiently to control the gastric motility and regulate the secretory functions of the glands of the mucosa for a period of not less than forty-eight hours.

Hyperperistalsis must be overcome. A constant stretching and relaxation of the tissues about the ulcerated area will not only increase the pain, but will not permit the ulcer to heal.

Severe intermittent, persistent, tetanic spasms of the gastric musculature must be prevented to assure the comfort of the patient.

Hypoperistalsis should be produced to such a degree that the peristaltic wave practically disappears. This is conducive to lessened irritation and rapid healing.

General relaxation of the gastric musculature should be produced as it not only lessens the hypermotility but causes a dilatation of the pylorus, thereby permitting the gastric contents to pass more freely.

The vascularity about the ulcerated area must be increased to enhance the local resistance and promote the reparative process.

Extreme hyperacidity must be lessened either by controlling the function of the acid secreting glands or by relative dilution, which is accomplished by stimulating the secretory function of the prepyloric and cardiac glands. Dilution of the free hydrochloric acid must be carried to such an extent that the gastric contents are only faintly acid or nearly neutral. Free hydrochloric acid not only irritates the ulcerated surfaces, but increases the pain.

Hypoacidity should be produced to such an extent that the amount of free hydrochloric acid is much below normal. The total acidity of the stomach does not need to be considered as the free hydrochloric acid is the agent that produces irritation and delays healing.

There must be an increase of the non-irritating digestive enzymes to facilitate gastric digestion when the stomach is devoid of peristaltic action. This secretion must be sufficient to liquefy the contents of the stomach to such an extent that they will pass through the pylorus with lessened peristaltic movements.

Alkaline secretions and digestive enzymes may be increased from twelve to eighteen times by sufficiently stimulating the vegetative nerves. This can be accomplished, as shown by animal experimentation, with certain proteins.

In addition to regulating physiologic functions as outlined here the agent must destroy or at least inhibit the growth of the infective organism without exerting a toxic action on the normal tissues. Infective foci in the teeth, tonsils, sinuses, etc., should be removed to obtain the results desired.

The surgeon who has observed the abdominal viscera during inhalation, spinal, and splanchnic anesthesia will have noted that under inhalation anesthesia the stomach and intestines are always dilated, over-distended, and that there is no peristalsis. When high spinal or splanchnic anesthesia is employed for non-infective intra-abdominal conditions, there is a normal or increased peristaltic wave, the stomach is small, contracted or collapsed, as also are the intestines. The general belief that gastric dilatation or abdominal distention is due to splanchnic paralysis is a misconception since the arrest of peristalsis is not coincident with splanchnic paralysis, but on the contrary is produced by bacterial or protein stimulation of the splanchnic plexus. This is clearly demonstrated in general or localized peritonitis. The spinal anesthesia is then unable to

overcome the intestinal distention. The action of protein stimulation may also be observed when a blood transfusion is given during an operation under spinal or splanchnic anesthesia. The intestines immediately become distended and peristalsis ceases. The intestinal vessels dilate and a mild hyperemia is observed. The same results may be produced by the injection of certain mild proteins that will not cause a systemic reaction or produce a chill.

Our early experiments were accompanied by such severe reactions that the patients registered innumerable complaints, the principal one being a severe rigor lasting from two to six hours. The proteins injected were obtained from vaccines made from direct streptococci cultures, and later from autogenous serums, none of which could be so developed that they would not produce the anaphylactic symptoms, chill, perspiration, nausea, vomiting in greater or lesser severity, unless given in such minute doses that they were of no therapeutic value.

Animal experiments demonstrated that we could produce the same reaction on the vegetative nerves without causing protein shock. This was a marked contrast to the results experienced when using pathogenic proteins. Certain non-specific proteins were found to cause little or no anaphylactic reaction, such as chill, rise in temperature, nausea, vomiting, perspiration, etc., although experimentally and clinically the desired results were obtained. By combining these non-specific proteins with lipoids, animal fats and emetine, we were enabled to control and prolong the elective action so that it persisted for many hours.

It seems needless to stress the fact that a definite diagnosis is essential in the treatment of gastric ulcers. Even with our modern laboratory methods one is confronted with uncertainties. Therefore, it is advisable to employ gastric analyses, test powders, and roentgenograms in addition to the clinical symptoms to exclude the possibility of cholecystitis with adhesions, chronic appendicitis, gastric or intestinal polypi, malignancy, gumma, or girdle pains of tabes, etc. We have had 2 cases with typical clinical symptoms of peptic ulcer which could not be satisfactorily demonstrated either by *x*-ray or gastric analyses. The symptoms were relieved by magnesium oxide (5 grains), sodium bicarbonate (25 grains) and bismuth subcarbonate (30 grains) taken after meals and whenever the pain became severe. From the clinical symptoms and relief obtained by the alkaline powder we assumed that an ulcer existed. Both patients were relieved by intravenous injections of the synergistic solution without other medication, the powders merely being used to confirm the diagnosis. Peptic ulcers may and often do exist without producing symptoms, or the symptoms may occur periodically. Two persons recently treated were totally symptom free during the winter months, but have suffered with gastric distress for four and six years respectively during the summer months. They have attributed their symptoms as due to indigestion from eating berries. The *x*-ray showed that both of these patients suffered from ulcers.

Clinically, pain is the most prominent symptom of which these patients complain. It may be described as sharp, dull, boring, burning, constant or intermittent. It may be so slight that it is described as a passing twinge, or so severe as to require opiates. It may appear immediately after eating, but usually is more intense from two to four hours after the ingestion of food. When the pain occurs two or three hours after a meal it may usually be relieved by a glass of milk, light food, or the administration of some alkaline powder, as either food or alkali medication reduces the degree of acidity. The pain is largely influenced by the character of the food. Bland articles such as milk, eggs, cereals, broths, custards, jellies, etc., are less apt to produce distress than are highly seasoned and heavy dishes. Alcoholic beverages invariably increase the gastric distress and often so irritate the ulcerated surface that pain does not disap-

pear for days and weeks. The number of peptic ulcers seen in European hospitals is striking as compared to those observed in

respiratory and digestive tracts can be excluded. The presence of blood in the stools should be considered suggestive of a

Fig. 1. Stomach of Mrs. A. W., at time treatment was started, showing well defined ulcer. Hypermotility.

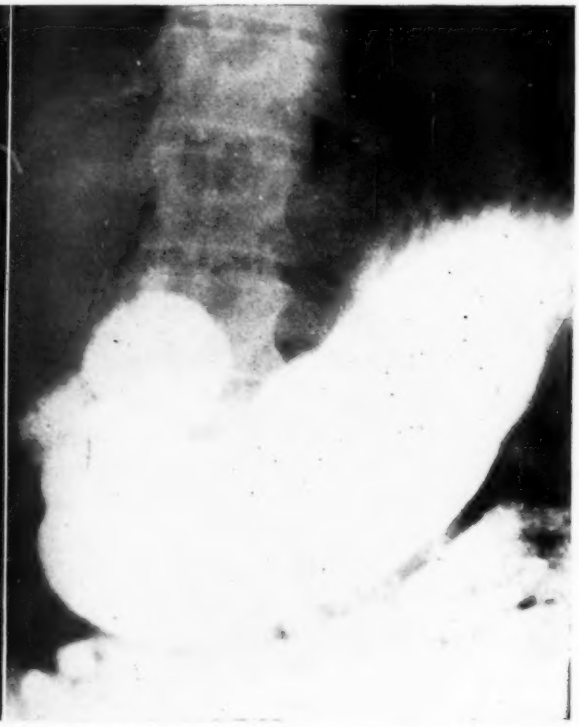

Fig. 2. Stomach of Mrs. A. W., two months later, ulcer not visible, duodenum dilated. Hypomotility.

America. Possibly this is due to the highly seasoned, greasy foods customary to the continent. It may be attributed to the free indulgence of alcohol or possibly is caused by the very bad oral hygienic conditions, which exist among the poorer classes.

Observing the action of alkalies, Sippy recommended magnesia, bismuth and sodium bicarbonate to differentiate the pain caused by an ulcer from other pain producing pathologic conditions of the stomach or duodenum. Vomiting may or may not be considered as a diagnostic symptom. It probably occurs more frequently in pyloric than in gastric ulcers. When vomiting occurs the pain is invariably relieved. Should blood be present in the vomitus, either as a faint trace or as a moderate hemorrhage, it is of considerable diagnostic value, provided that bleeding from the gums, nose or other parts of the gastric or duodenal ulcer. Unfortunately in these cases we have no characteristic clinical syndrome by which we are able to make a definite diagnosis of either gastric or duodenal ulcer, as jejunal polypi may produce similar symptoms that are quite impossible to differentiate clinically.

Unquestionably the *x*-ray is one of our most valuable aids in diagnosis. The presence of a duodenal ulcer is demonstrated positively by this means in almost every case, be it by actual view of the barium-filled crater, or constant deformity of the cap; indirect signs, such as hypermotility and increased tone of the stomach point to duodenal ulceration, but are merely confirmatory. Gastric ulcer, however, though demonstrable in many cases by the use of the opaque meal and the *x*-ray is unfortunately not to be diagnosed with any comparable degree of certainty. Posi-

tive diagnosis, where an ulcer crater fills and shows on the fluoroscopic screen or skiagraph, is beyond question; but a negative diagnosis is far from absolute, as a small ulcer or one confined to the mucous membrane may be missed. The "crossbar" sign of Fraenkel, where a peristaltic wave advances as far as the lesion, fades out, then reappears distally to pass onward to the pylorus, never passing through the site of the ulcer, is strongly suggestive. The roentgenologist may deduce from the alterations in the gastric motility and emptying time, that an ulcer is present, but his conclusions are, at best, only inferential. Again, *x*-ray examination is unable to reveal the onset of malignant change in a previously benign ulcer.

We must, therefore, resort to a combination of diagnostic aids in numerous cases before a definite diagnosis may be obtained with reasonable certainty.

As it is impossible to include in this article all of the results obtained in this preliminary series treated with the synergistic solution we will illustrate some of the more striking cases with skiagraphs taken before and after treatment, together with the accompanying histories. Some of these cases were hospitalized, others were ambulatory, and needless to say those selected for demonstration here, were among the most severe of the series. The lesions were the most pronounced and so marked that they are clearly demonstrable. The dates on the skiagraphs show the results obtained in a comparatively short time. These patients, as well as the others treated, are at the present time symptom free.

Fig. 3 . Marked lesion of duodenum August 28.

Fig. 4. Duodenum has assumed appearance approaching normal.

Case 1 (Private Office). Mrs. A. W., an American housewife, aged thirty-one, was referred for diagnosis and treatment September 11, 1930.

The *family history* was essentially negative.

Previous history and present condition: The woman had been having stomach trouble for six years. In April, 1926, while in a department store, she had a severe gastric hemorrhage, fainted, and was removed unconscious to a hospital. Here she remained under treatment for two weeks and was then permitted to go home. She continued under medical supervision for several months. The epigastric pain became aggravated by indiscretions in diet,

the painful attacks usually continuing for periods of two or three weeks. At the time of the hemorrhage she weighed 134 lb., but was never able to increase her weight above 126 lb. thereafter.

Fig. 5. Ulcer in case of Mr. MacN. clearly demonstrable. Note barium elevating peritoneum.

Six months before she came under the author's observation she had another (slight) hemorrhage, after which the pain had been almost continuous. During the latter part of August she had a moderately severe emesis; according to her statement the vomitus contained bright red blood and a black substance that looked like coagulated blood. She had rarely vomited at other times. There was no clear history of tarry stools.

At the time of examination, she complained of severe pain at the costal arch, which was most intense in the middle of the forenoon, the middle of the afternoon, and during the night. She had to get up several times at night to take milk or sodium bicarbonate, which gave relief for one or two hours. She stated that the pain radiated to the left side along the border of the ribs.

Physical examination: The abdomen was symmetrical, scaphoid. Upon palpation, tenderness was elicited below the ensiform, almost in the midline. Percussion disclosed the lower border of the stomach at the umbilicus. There were no areas of rigidity, pain or tenderness in the lower abdomen. Vaginal and other physical examinations yielded negative findings. Temperature 98.4°F.; pulse 108; respiration 36. Hemoglobin 60; erythrocytes 3,600,000; leucocytes 11,200 (polynuclears 48, small lymphocytes 46, transitionals 5, basophiles 1). Blood pressure 110–62. Urine alkaline; specific gravity 1.010; no albumin; no sugar; acetone plus; no indican; a few pus cells and epithelial cells.

A provisional diagnosis of peptic ulcer was made from the previous history. An intravenous injection of the synergistic solution was given. At this time roentgenologic examination of the gastrointestinal tract was advised. Upon completion of the serial roentgenograms, September 14, the diagnosis of penetrating preduodenal ulcer was confirmed (Fig. 1). Somewhat less than two months later, the ulcer had apparently disappeared (Fig. 2).

The patient experienced no pain or digestive disturbance after the first injection, and has been free from symptoms since. At the present time she is not subjected to any restrictions in diet, with the exception of alcoholic beverages.

Case II. No. 13279, Mr. L. J., a Jewish salesman, aged fifty-two, entered the hospital August 26, 1930, referred for gastroenterostomy by his nephew, a physician. The family history was negative.

Previous history and present condition: He was perfectly well until 1927 when he first complained of epigastric pain, which became very intense about one and a half hours after meals, he was nauseated between meals, had gas and belching, and lost weight progressively. Entered Mt. Sinai Hospital, New York City, where a diagnosis of duodenal ulcer was made, and confirmed by *x*-ray. He remained in the hospital five weeks on medical and dietary treatment. After being discharged he conscientiously adhered to medical treatment and diet, but grew progressively worse. He returned to the hospital in 1928 and 1929, each time remaining for six weeks. At first he had pain over the whole upper abdomen, beginning about one and half hours after meals. This relief interval gradually shortened until the pains began about a half hour after meals and persisted until he ate something. To have any degree of relief it was necessary for him to take

food about every hour. The pain had been most persistent at night, and in the last eight months so severe that he could not sleep. For two years he had been unable to work. He had spells of nausea several times a day and vomited two or three times a week. The vomitus contained no blood.

Physical examination: Definite tenderness over the entire epigastrium was elicited. There was no rigidity or palpable mass or distention. He had many decayed teeth and marked pyorrhea. No other pathologic signs were demonstrable with the exception of hypertrophy of the left ventricle. Erythrocytes 4,600,000, leucocytes 7200 (polynuclears 58, small lymphocytes 38, transitionals 4) hemoglobin 80. Urine analysis and Wassermann reaction were negative. Weight 124½ lb. (in 1927 it was 174 lb.).

Serial roentgenograms confirmed the diagnosis of duodenal ulcer. Permission was obtained to try the synergistic solution before resorting to surgery. Eight injections were given at three-day intervals. After the third injection the patient was free from pain. Four weeks after the first injection, he was permitted to eat meats, fruits and vegetables. On October 26, the weight had increased to 145 lb. The patient is still on a full diet and is symptom free (Figs. 3 and 4).

Case III. No. 12895. Mr. MacN., an American salesman, aged thirty-two, entered the hospital July 10, 1930 for diagnosis and treatment.

The *family history* was negative.

Previous history and present condition: He had indigestion for over a year, partially relieved by diet and medication, but severe if medicine was discontinued or the diet not strictly adhered to. The stomach distress was most intense about one hour before meals and was relieved by food. For four weeks he had been gradually losing weight and strength. Indigestion had been worse, and there were frequent dizzy spells and headaches. There was no vomiting. The stools had been black.

Physical examination: The patient, 5 ft. 11 in. in height, weighed only 135 lb. but nutrition was fair. The abdomen was pale and scaphoid, the musculature not well developed. There were slight tenderness and rigidity in the mid-epigastrium, most severe just below and to left of ensiform. The pain did not radiate. There were no palpable masses. The liver and spleen were not unpalpable and there were no enlarged glands.

Temperature 99°F., pulse 96; respiration 20.

Fig. 6. Change that has taken place in less than three months.

Blood pressure 120–76. Erythrocytes 1,880,000, leucocytes 9800 (polynuclears 72, small lymphocytes 26, eosinophiles 1, transitionals 1, many poikilocytes, few macrocytes and microcytes): hemoglobin 36, type 4; coagulation time three minutes, stools blood 4 plus. July 12, 1930, blood pressure 105–70. Erythrocytes 1,660,000, hemoglobin 30. Serial roentgenograms demonstrated the presence of a perforating gastric ulcer (Fig. 5). Urine was alkaline; specific gravity 1.012; no albumin, sugar, acetone or indican. At this time the patient was given 6 c.c. of synergistic solution intravenously, repeated on the third, sixth, ninth, twelfth and fifteenth days. July 13, 1930, the patient was comfortable, had no epigastric pain and suffered no indigestion. July 21, 1930, erythrocytes 2,800,000; hemoglobin 43; stools negative for blood. July 30, 1930, blood pressure 120–80. Erythrocytes 2,920,000; hemoglobin 44; stools negative for blood. The patient was discharged on July 30 and returned to work on September 1 with no pain or indigestion, weighing 154 lb. September 22 the patient was absolutely

symptom free, erythrocytes 4,110,000, hemoglobin 62, the ulcer apparently healed (see Fig. 6).

Fig. 7. Stomach and duodenum of P. W. M. before treatment was started. Marked stenosis of pylorus and contracture of stomach as described in history.

Case iv. Dr. P. W. M. an American physician, aged forty-five.

Family history negative.

Previous history and present condition: In 1918 he began to have periodical attacks of epigastric pain, some belching of gas and regurgitation of food. These attacks, lasting for one to three weeks, were rather mild, but gradually increased in severity. In 1920 the pain was sometimes so severe that codeine was required for relief. It was aggravated by acid fruits or alcoholic beverages. In 1924 severe periodical attacks of pain were accompanied by vomiting (no blood). A New York gastrologist made a diagnosis of duodenal ulcer on *x*-ray findings, and prescribed a strict diet and an alkaline powder, which gave relief for some time. Indiscretions of diet caused the symptoms to return. By 1926 the hunger pains became so severe that he was forced to carry a thermos bottle of milk and egg with him on his rounds, as well as to bed; every night he consumed from a pint to a quart of this mixture. He habitually pressed his hand over the pit of his stomach, as the pressure brought relief. During this interval dietary and alkaline medication had been followed at various times for two to six months. Previous to June 1930 he had been unable to eat solid food, subsisting solely on milk, milk and egg mixtures and broths. The capacity of the stomach was 7 oz., and a greater quantity of liquid would regurgitate. X-ray examination taken on June 14 showed almost complete obstruction of the pylorus (Fig. 7) with marked contracture of the stomach.

Fig. 8. Results obtained in P. W. M.'s case after three and a half months' treatment. Compare size of two stomachs.

Physical examination: The patient, 5 ft. 7 in. in height, weighed 142 lb.; nutrition was fair. Blood pressure 123–66. The abdomen was tender on deep pressure to the right of the midline, but light pressure was comforting. The liver and spleen were not enlarged. Genitourinary organs were negative. Urine was acid, specific gravity 1016; no albumin, sugar, or acetone; indican 2 plus. Feces negative for blood. Erythrocytes 4,620,000, leucocytes 9300, hemoglobin 75, (polynuclears 74). A diagnosis of pyloric ulcer with stenosis was made. From June 14 until July 10 the patient had eight injections of the synergistic solution intravenously at three-day intervals. He was completely relieved of pain after the second injection. On July 19, 1930, the patient attended a testimonial dinner and ate various foods without suffering distress. On July 24, he went on an extended trip during which he ate all kinds of food without discretion and resumed

his habit of drinking six to ten cups of coffee a day. He indulged moderately in beer, wines and liquors without distress. He has had no pain or recurrence of old symptoms since the second injection. He has gained weight, and is able to eat a hearty meal. On September 30, the *x*-ray examination showed that the stomach was increased in size (Fig. 8). The duodenal lesion had apparently disappeared.

Fig. 9. Lesion in stomach of Mr. J. T. clearly visible as indicated by arrow.

Case v. Mr. J. T., an American printer, aged forty.

Family history was essentially negative.

Previous history and present condition: The patient had been a moderate drinker for a number of years, always taking two or three drinks on the way home from work, occasionally a drink in the morning. He indulged in periodical sprees. In October 1929, he weighed 137 lb., but at the time of admission only 113 lb. For the past two and a half months he had been treated for pain localized under the costal margin, which was not aggravated or relieved by eating, but was allayed for one and a half to two hours by powders he was taking. There was no discomfort at night. On June 29, 1930, he had a number of drinks with a friend. At night he vomited a few times, the vomiting persisted with increased frequency after that time. The day before admission he vomited about 2 qt. of a dark brown material.

Physical examination was negative except for an extreme tenderness just below the ensiform and along the left costal margin. The free hydrochloric acid content of the stomach (from examination of the vomitus) was 55. The vomitus and stools both contained blood. *X*-ray examination and intragastric photography demonstrated a perforating ulcer of the lesser curvature (Fig. 9). On July 7, 1930, he was given 6 c.c. of the synergistic solution intravenously. This rapidly curtailed the vomiting and lessened the pain. On July 9, 1930, a second injection was given and on the next morning, the patient had no pain. The intravenous injections were continued at three-day intervals until July 24. On his return, September 24, 1930, the *x*-ray examination (Fig. 10) showed the ulcer completely healed. His weight was 143 lb., more than it had ever been.

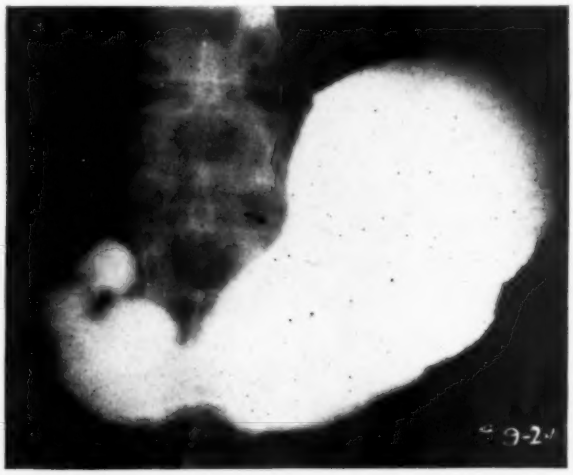

Fig. 10. Note appearance of lesser curvature of stomach where lesion has disappeared.

Case vi. Mr. M. C. Q., a publisher, operated upon 1928 for ruptured duodenal ulcer. Pain persistent until May, 1930, at which time he was given six injections. Pain was relieved after second injection and to date is symptom free.

Case vii. Mr. M. C., a carpenter, heavy drinker, operated upon twenty hours after rupture of duodenal ulcer. Eleven days after operation complained of severe pain. The injections were started. Pain was relieved after first injection, to date is symptom free.

The other patients with repaired ruptured duodenal ulcers were started on treatment the day following the operation. None of them complained of pain and have been symptom free.

Case viii. Mr. J. M. was subjected to

gastroenterostomy in 1927. The pain persisted to 1930, but was relieved after the first injection. Ten injections were given in all.

Case IX. Mr. T. P., gastroenterostomy, German Hospital, New York, 1914. Pain persisted until 1930; was completely relieved after six injections. Gain of 30 lb. in weight.

Case X. Mr. J. L., operated on in 1924. No relief from pain. Pain ceased after second injection; symptom free.

Case XI. Mr. H. A., gastroenterostomy in 1927. Pain persisted. Eight injections; symptom free.

Case XII. Mr. E. T., gastroenterostomy in 1927. Pain persisted. Six treatments; no relief. Refused *x*-ray examination.

Case XIII. Mrs. A. S., gastroenterostomy in 1927. Pain persisted. Marginal ulcer excised in 1928. In April, 1930, severe gastric hemorrhage; transfusion. Eight treatments; symptom free since first injection.

In the hemorrhagic cases, intravenous therapy was given every second day. The vomiting ceased immediately in the 3 cases treated. The stools were negative for blood in three to five days.

The appendix and gall-bladder patients who had previously been operated upon for pain all had demonstrable duodenal lesions. These cases are of interest because the diagnosis was not completed at the time of operation.

A chronic appendix may have been removed without discovery of the ulcer, or the ulcer may have been the primary cause of pain, the appendix the innocent aggressor. The same may be said in regard to the gall-bladder cases.

Case XIV. Mr. A. B., operated upon in 1924 at Harlem Hospital for adhesions about the duodenum and gall bladder. Two weeks after he had gone home, he had a severe gastric hemorrhage and returned to the hospital where he remained three weeks for treatment. Pain persisted until 1930. Relieved after first treatment. No recurrence of pain.

One of the gastroptosis patients was completely relieved of pain. Two complained of heavy feeling after the series of treatment. A belt was applied in all cases.

The patient with syphilitic ulcer received no relief. He is now on antisyphilitic treatment.

The results in penetrating gastric ulcers are shown in the preceding cases.

In the cases of penetrating duodenal ulcers the follow-up *x*-ray examinations were not made.

The case histories and *x*-ray prints presented here have been selected because the lesions as well as the end-results are clearly demonstrable.

The technique of administering the synergistic solution is no more difficult than any intravenous medication. Apparently better results are obtained by using a fine 25 gauge needle and a 3 ring control syringe. A fine 25 gauge needle produces much less pain than does the larger 21 or 22 needle, so frequently used for intravenous work. The 3 ring control syringe permits of aspiration, assuring the operator that he is in the vein, and injection of the solution without changing the position of the hands. This obviates the possibility of the needle's slipping out of the vien or possibly perforating the inner wall. If for any reason the median basilic or median cephalic cannot be utilized the solution may be injected intramuscularly into the arm or the buttocks. If the intramuscular method is employed the patients may complain of some pain at the site of injection, but the discomfort is no greater than that produced by an ordinary hypodermic. It is inadvisable to inject the solution subcutaneously. If injected intradermally it produces a rather severe local reaction which may last for a week or ten days. As a routine the injections may be given twice a week or every third day. If the ulcer is producing intense pain or is bleeding the solution may be given daily or every second day until the symptoms are relieved.

It is preferable to inject the solution when the stomach is empty as the reaction is almost immediate, and if it is given

after meals vomiting may occur, not of the projectile type but a spontaneous emesis due to the relaxation of the cardia. Not infrequently after the intravenous injection, the patient complains of feeling a little light headed or possibly nauseated. This usually can be controlled by asking him to take a few deep breaths. Should the patient be dehydrated or have acidosis a dram of bicarbonate of soda given five or ten minutes before the medication usually prevents nausea or vomiting. Dizziness, nausea or vomiting rarely occur when the injection is given to patients in bed, but the reaction is so slight and occurs so rarely that it is not necessary to place the patient in a prone position. The milder cases are invariably free from pain after the first injection, but the severe ones or those with more chronic lesions are not as a rule completely relieved until after the third and sometimes the fourth injection. Six injections at intervals of three or four days usually suffice in the milder cases. Patients who have suffered for a long time or those with marked gastric or duodenal lesions may require eight doses. The maximum number of injections for one course is ten. If a second course of treatment is required, six to eight weeks should intervene.

It is essential that bland foods be given during the treatment. The diet need not be as restricted as the ordinary gastric ulcer diets or the Sippy diet. For the first week or ten days if hunger pains are troublesome, milk or milk and egg should be given at 10 A.M., 3 P.M. and 9 P.M. As soon as the pain has disappeared the food between meals may be stopped. The following diet has been given to patients for the first three weeks: Milk, cream, butter-milk, malted milk, ovaltine, coco-malt, milk and egg, soft eggs (not fried), bouillon, beef broth, veal broth, mutton broth, chicken broth, rice, barley, potato and celery soups, well cooked rice, farina, gruels, cream of wheat (no oatmeal), corn-starch custards, rice pudding, bread pudding, baked or mashed potatoes, plain vanilla or chocolate ice-cream, ices and plain sponge cake.

Tea, coffee and alcoholic beverages must be eliminated.

After the third week fish baked, broiled or boiled (not fried), white meat of chicken, peas, squash, spinach, mashed carrots, asparagus, fruit juices and stewed fruits, with the exception of berries. After the fifth week the diet is unrestricted with the exception of alcoholic beverages, preserved meats or fish.

Who is to determine whether a gastric or duodenal ulcer shall be treated medically or surgically. The internist usually attempts medicinal cure, and will not permit the patient to undergo surgical intervention except as a last resort. The majority of surgeons look upon these lesions as a surgical condition. In an article recently published, the Sippy diet was reported to have cured 49 per cent of all gastric and duodenal ulcers. If conclusions may be drawn from the small series here offered, apparently a greater number of cases are rendered symptom free by this method. At any rate, before radical surgery is considered, it is deserving of a thorough trial with the hope that the symptoms may be overcome without subjecting the patient to the dangers that often accompany a subtotal resection or gastroenterostomy. What percentage of cures can surgery actually demonstrate? This is very hard to estimate, there is such a large variation in statistics from different clinics.

The series of cases that are reported here is far too small from which to draw final conclusions. Possibly, enthusiasm has made us somewhat optimistic. We have discontinued other methods of treatment because the great majority of our patients are symptom free within three to six days. By the use of roentgenography it has been possible in from ten to twelve weeks to demonstrate in many of the gastric ulcer cases the healed lesion as well as a lessened deformity of the pylorus. The symptoms of obstruction both objective, and subjec-

tive, disappear and, although we cannot demonstrate a normal duodenum by fluoroscopy or roentgenography, there is a relaxation of the constricted area in practically all cases. One feels justified in reporting such findings. The patient is not compelled to discontinue his usual vocation. He does not lose time, does not have to be hospitalized and can be permitted a fairly liberal diet.

Time will demonstrate the end-results. At a future date these will be published.

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RECURRENT TORSION OF THE SPERMATIC CORD*

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STRANGULATION of the testis due to torsion of the spermatic cord is a well-recognized condition, though the individual practitioner meets it infrequently. There are 135 cases reported in the literature, the first of which appeared in 1840, but there is reason to believe that the condition is more common than this would indicate, and that it is often unrecognized. It occurs in all decades from infancy to old age, though most commonly about the age of puberty and in early adult life.

The predisposing cause of torsion seems to be some abnormality of development, for incomplete descent was present in over half of the recorded cases, among which are 7 cases of torsion of intra-abdominal testes.

Etiological factors which have been suggested are

1. An unusually loose scrotum
2. A voluminous tunica vaginalis
3. An unusually long gubernaculum
4. An abnormal attachment of the cord to the testis.

Of these, the last two seem to be the most important, and it is easy to see how they might be associated with incomplete descent which is only one aspect of faulty development.

Ordinarily the reflection of the parietal layer of the tunica over the epididymis forms a mesentery (mesorchium) running from the globus minor to about the middle of the globus major. In most of the recorded cases of torsion, where the pathology has been noted, this mesentery has been much shortened, including only the globus major. The testis is suspended near the lower end of a "cable" consisting of the cord and the gubernaculum. Ordinarily when the mesentery described here is broad, and the gubernaculum short, a twist of the testis along the axis of this cable would be difficult to produce. But if the mesentery is narrow and the gubernaculum long, the testis is attached by a narrow band to the cable, and farther from the fixed lower end of it than normally, and it is easy to conceive of rotation, either around the axis of the cord and gubernaculum, or of the testis and its mesentery on the cord.

The first effect of this rotation is flattening of the veins and partial obstruction of the venous return; then as the rotation continues there occurs successively, obliteration of the veins, partial obstruction of the artery, and finally obliteration of the artery.

The effect on the testicular mass depends on the degree of torsion. If the venous return is not completely obstructed there will be congestion and edema, especially of the epididymis, which is more distensible than the testis. If the venous return is entirely obstructed, the congestion is greater and necrosis occurs in a short time. Of course, if the twist is sufficient to obliterate the artery, infarction occurs.

In some cases, operation has shown this pathological condition in patients having attacks like torsion but no torsion found. Probably spontaneous detorsion had taken place after necrosis had occurred. If detorsion is brought about soon enough, necrosis may be prevented, but even so, some degree of atrophy may result. It can be seen that repeated torsions, even when not extensive enough to cause complete blockage of the veins, by causing repeated congestion, might eventuate in atrophy.

The majority of the atrophic testes which we see are undoubtedly due to mumps; but it is probable that torsion is responsible for a certain proportion, either acute complete torsion or the incom-

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plete possibly recurrent type, unrecognized as such and wrongly diagnosed as epididymitis. In these latter cases, had the true condition been recognized and proper measures taken, atrophy might have been prevented.

Most of the cases reported in the literature are those of complete strangulation with resulting gangrene. Since the symptoms are quite severe, operation has usually been performed and orchidectomy has been the rule. In a few cases detorsion has been possible when seen early, and there are a few cases of repeated attacks of incomplete torsion, and fewer still of incomplete torsion occurring over a fairly long time, and treated repeatedly by detorsion.

The following case is deemed worthy of report as illustrative of the condition last mentioned, and because it presents some very unusual features. These cases are rare, but may occur more commonly than they are recognized, and their recognition may prevent a few cases of testicular atrophy.

CASE REPORT

Dr. R. M., physician, interne at the Henry Ford Hospital, aged twenty-seven, married, was seen in the spring of 1929, complaining of a sudden attack of epididymitis, left. He gave a history of recurrences of this condition for twelve years, and had consulted urologists in various cities, being given diagnoses of tuberculous epididymitis, traumatic epididymitis, etc. There was no history of venereal disease; no fever or leucocytosis in attacks; the onset was usually sudden and recovery after a day or two equally rapid and always complete, no induration of the epididymis persisting.

Examination showed as follows:

Well-developed white adult.

Height 5 ft. 5½ in.

Weight 132 lb.

Temperature 98.6, pulse 80, respiration 18.

Pupils reacted to light and accommodation.

Tonsils had been removed, otherwise there was nothing unusual in nose and throat.

No general glandular enlargement.

Lungs clear to auscultation and percussion.

Heart not enlarged, no murmurs.

Blood pressure 120/80.

Abdomen showed no masses or tenderness.

No abnormality noted in extremities—deep reflexes normally obtained.

Prostate and seminal vesicles normal to palpation.

Urine—not remarkable.

The scrotum showed no edema. The left testis was a little larger than the right, rather tender, and the epididymis was enlarged—not indurated, and very tender. It lay in its normal position as regards the testicle. The testicular mass was too tender to permit much examination.

He was sent home to rest, and the next day reported back to work, the testis and epididymis showing no signs of any disturbance.

He was seen in two similar attacks before the true diagnosis was made, and detorsion attempted successfully by the patient himself. Since then he has had numerous attacks, relieved immediately by detorsion. Operation is advisable, and the patient expects to have this done, but has not yet found it convenient. He has been examined several times in intervals between attacks. The left testicle is possibly a trifle smaller than the right, but its consistency seems the same as the right. The globus minor cannot be felt. Near the upper pole the globus major is palpable, but apparently is a little above the testis. It is evident that very little atrophy has taken place and that the attachment of the epididymis to the testis is abnormal. Descent seems complete. He reports that in the attacks there is always one complete twist clockwise. Recently in performing detorsion he has had to rotate the testis end over end as well as counter clockwise.

The following is an account and description of his attacks written by the patient himself:

Date	Attack	Relieved by
Summer 1917	First attack following a fall on a bicycle.	Rest and cold compresses to scrotum.
Fall 1917	Attack following exercise.	Sleep and cold compresses to scrotum.
Spring 1918	Following lifting of heavy weights.	Sleep
Summer 1920	Several attacks, always associated with mountain climbing (when suspensory was not worn).	Sleep and relaxation.
1921–1922	One or two attacks. Details not clear.	
Fall 1923	Two attacks. No apparent cause.	Sleep and rest.
Sept. 1925	Severe attack, following pushing a car from a ditch.	Sleep and relaxation.
July 1926	Attack, no apparent cause.	Rest and relaxation.

Date	Attack	Relieved by
July 1927	Severe attack, following pushing car from ditch.	Morphine, sleep and rest.
Jan. 1928	Attack, no apparent cause.	Sleep and cold compresses to scrotum.
March 1928	Attack, no apparent cause.	Morphine, sleep and rest.
July 1928	Attack, no apparent cause.	Rest in bed.
Jan. 1929	Attack, no apparent cause.	Rest in bed and sleep.
March 1929	Attack, no apparent cause.	Hot bath, rest and sleep.
April 1929	Attack, no apparent cause.	Hot bath, rest and sleep.
May & June 1929	Three attacks, two of which have been successfully relieved by untwisting of the left testicle.	

CHARACTERISTICS OF ATTACKS

Pain is always limited to the left testicle, and is always of the same character with each attack, i.e., severe constant pressure type of pain which does not radiate.

Scrotum does not swell or become edematous, but the left testicle becomes hard and swollen, filling the scrotum. The epididymis becomes swollen and very tender.

No abdominal pain or tenderness associated with attacks, and no fever or leucocytosis observed.

Attacks have been coming more frequently of late, but are of a less severe degree.

From June, 1929 to June, 1930, untwisted many times.

One complete twist clockwise present always. More recently has had to rotate it end over end.

Only very slight atrophy if any.

DISCUSSION

The diagnosis of this condition presents some difficulties, especially in the first attack or when the patient is seen in one attack only. Probably the most important diagnostic point is the position of the epididymis. Normally the epididymis lies posterior and medial to the testis. In case of torsion, if the twist is through 360° or any multiple of it, the epididymis will lie in the normal position, otherwise not. This applies to acute complete as well as to the incomplete and recurrent types. In the complete type it is sometimes difficult to recognize the epididymis on account of the swelling and tenderness of the whole testicular mass. In the attacks of recurrent torsion, the obstruction to circulation is not complete and, as in the case here reported, the swelling may be largely confined to the epididymis, making recognition of its position rather easy.

The history gives another important lead to the diagnosis. A history of repeated attacks with rather sudden onset and rapid recovery with no apparent residual induration of the epididymis is almost diagnostic, particularly if the affected testis is a little smaller than the other. The absence of previous venereal disease may be important and the lack of fever, leucocytosis or pathological urinary findings may also be of assistance, as well as the finding of seminal vesicles normal to palpation.

A correct diagnosis is important, for on it the health of the affected testis depends. Undoubtedly repeated occurrences of congestion and ischemia will eventually result in some degree of atrophy, and there is always the possibility that in any one attack the obstruction may become complete and infarction result. If the diagnosis be made, the testis may be rotated so as to untwist the cord and thus relieve the situation for the nonce. Nevertheless some operative procedure for the prevention of future twists should be undertaken as soon as convenient.

An interesting point in connection with torsion is that on the left the twist is usually clockwise, and on the right counter clockwise, and this might be remembered if an attempt be made to untwist.

The predisposing causes have been discussed. The exciting causes are many: almost any kind of trauma affecting the cord or testis, almost any kind of muscular exertion, and in many cases no exciting causes were evident. It will be noted that in the case reported, some kind of unusual exertion seemed to be the commonest exciting cause.

A few cases similar to this one have been reported, and probably many have gone unrecognized. Dowden, in 1905, in reporting a few cases, introduced his paper with the following paragraph:

"Torsion of the spermatic cord occurs with greater frequency than is generally

supposed, and the reason why it is not more often recognized is due to the absence or scant information in most surgical text books . . . With regard to recurring torsion of the cord, there is very little information."

This statement is almost as applicable today as it was when it was written.

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* Continued from p. 509.

ANNULAR PANCREAS

ASSOCIATED WITH PEPTIC ULCER*

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DURING the past year the author[1] reported the twenty-ninth case of annular pancreas in the medical literature. Since then Howard[2] reported an additional case bringing the total of previously reported cases up to 30. In spite of the fact that Howard missed several cases in reviewing the literature, his article is highly recommended to the reader for the fine drawings illustrating the embryology of the pancreas and the possible explanation of the embryological defect.

The 2 cases observed by the author were found in the routine prosection at about 2500 necropsies, in 1468 of which especially attention was given to anomalies of the pancreas. In the first case acute hemorrhagic pancreatitis was present in the main and annular portion of the pancreas, a combination which probably has not been otherwise observed. The report of the author's second case and the thisrty first case reported in the literature is a-follows:

The patient was a forty-four year old English laborer who was admitted to the Receiving Hospital on May 13, 1930, complaining of epigastric pain, belching of gas and vomiting. The first two of these symptoms began three years before. The pain occurred from ninety to one hundred twenty minutes after the intake of food and was relieved by either milk or solid food. In the last year the pain became more severe and he vomited occasionally. He had twice been a patient in another hospital, in August, 1929, and April, 1930, where a diagnosis of peptic ulcer was made. His condition became progressively worse on medical treatment; he had lost weight and had become very weak. He had not had diarrhea or blood in the stools. The history by systems was otherwise unimportant.

The physical examination revealed a white male adult who was somewhat emaciated but did not appear acutely ill. The epigastric region was tender to moderate pressure but there was no spasiticity or palpable tumor.

FIG. 1. Annular pancreas associated with chronic peptic ulcer.

The radiographic examination showed a large dilated stomach with hyperperistalsis emptying through a persistently deformed bulb. At the end of six hours there was 60 per cent retention and 30 per cent in twenty-four hours. The laboratory findings were unimportant except for a 4–2–1–0–0 Kolmer test and a 2 plus Kahn.

With a preoperative diagnosis of stenosing duodenal ulcer a gastroenterostomy was performed under spinal anesthesia on May 27, 1930; a chronic ulcer, the crater of which was 12 mm. in diameter, was found on the lesser curvature. Following operation he developed a respiratory infection with an accumulation of fluid in the right pleural cavity and on June 12, 1930, the sixteenth postoperative day, he expired.

At autopsy bilateral acute fibrinopurulent

[1] Brines, O. A. Annular pancreas involved in acute hemorrhagic pancreatitis. *Ann. Surg.*, 92: 241, 1930.

[2] Howard, N. J. Annular pancreas. *Surg. Gynec. Obst.*, 50: 533, 1930.

* Submitted for publication December 23, 1930.

pleurisy and pericarditis with pleural and pericardial effusion was found. The right pleural cavity was filled with thin purulent fluid which collapsed the lung against the mediastinum. The left pleural cavity was one-third filled with less turbid fluid and the pericardial sac contained 100 c.c. of the same material. An old ulcer 22 mm. was found on the lesser curvature of the stomach. The distance from the nearest edge to the pyloric ring was 15 mm. The duodenum was completely encircled and slightly constricted by a ring of pancreatic tissue which connected posteriorly with the head of the pancreas and anteriorly with the uncinate process. The inner diameter of the ring was 22 mm., its thickness 6 mm. and its width from 15 to 22 mm., the narrowest portion being the anterior aspect and the widest portion to the right of the duodenum where one would expect it to be narrowest. The anastamosis of the stomach and jejunum was properly in place and healing had progressed normally.

SUMMARY AND CONCLUSIONS

1. An additional case of annular pancreas is reported bringing the total of reported cases up to 31.

2. In this case annular pancreas and gastric ulcer was present together, the combined clinical and radiographic evidence pointing to a stenosing duodenal ulcer.

3. Had this patient recovered, symptoms of partial obstruction would probably have persisted because surgical attention was not directed to the annular pancreas.

4. Failure of the surgeon to appreciate the full importance of the pathology present was doubtless due to the rareness of the condition.

5. The few cases in the literature probably do not reflect the true incidence of the condition and the author hopes that by directing attention to it more cases will be recognized and that in the future annular pancreas will receive its proper place as a pathological and surgical entity.

REMOVAL OF PEDUNCULATED GROWTHS

OF THE SIGMOID AND UPPER RECTUM*

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CERTAIN types of pedunculated growths such as adenomata and fibromata are found in the upper rectum and sigmoid occasionally. They require surgery because they are prone to bleed and may be starting points of the carcinomata found in this region. Of course such tumors may be excised by the abdominal route, but as this involves enterotomy and suture of the gut it carries the usual risk of such a procedure. Removal from below is free from this objection and may be carried out in growths situated a considerable distance from the anus. In a recent case the writer succeeded in excising by this method a border-line adenoma the size of a large strawberry 10 in. from the anal margin. However, in operations through the rectum certain points should be borne in mind and these will be discussed here.

PRACTICAL CONSIDERATIONS

The first one is good illumination through an operating sigmoidoscope of proper length and diameter, as it is risky to work in poor light. The writer uses an electric instrument of special make 12 in. long and 1¼ in. wide which may be connected through a rheostat to any standard electrical fixture. But it is not essential to have this, as a head mirror with a 15 Watt lamp will do, if one is accustomed to that kind of light. An instrument of this size will not pass the rectosigmoid junction except under anesthesia because of a narrowing of the bowel at this point by a thickening of the circular muscular fibers (O'Beirne's sphincter), and regional block seems especially suitable here by reason of its property of inducing a most complete relaxation. For pedunculated tumors of the posterior wall of the rectum or dorsal aspect of the gut the knee-chest position is desirable because those so located will be displaced by gravity, fall downward and become easily visible and readily accessible. But as under spinal anesthesia the patient cannot maintain himself in this position voluntarily, it is recommended that the reverse lithotomy posture be used. This is done by depressing the head of the table and supporting the abdomen by sand bags placed in the groin, flexing the thighs and allowing the feet to hang over. It has been found in practice that when there are kinks, adhesions or angulations of the bowel it may be difficult to insert the instrument far enough at operation to find the growth if it is above the rectosigmoid junction. In such cases it strikes what appears at first glance to be a solid wall and cannot be made to go beyond it. To overcome this, the writer advises that a ball of cotton on the end of a placental forceps be pushed into the center of the proctoscopic field which will at once show the direction of the gut; it may then be lifted up, straightened and the sigmoidoscope passed upward easily. When the growth is in full view, it is grasped with the forceps and snipped off at its base with a modified Eaves' wire snare. To be assured that it will be cut off at the proper place it should be held by the forceps and steadied, when not only the pedicle but the portion of the bowel from which it springs may be removed and the wall cauterized. The regulation Eaves' snare is 4 in. long but may be easily lengthened and the position of the rings adjusted to suit. If one does not cut deeply the resultant bleeding is negligible, but there may be a hemorrhage which cannot be controlled if a blood vessel has been severed. A good way to meet this is by applying to the bleeding

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spot a long handled artery clamp which can be left in place as long as desired; but as this cannot be withdrawn through the operating sigmoidoscope on account of the rings, the writer devised a special clamp for this purpose. This is an artery clamp with 12 in. handles in which the rings have been entirely eliminated and replaced by oval concave plates to permit a good hold. It is found that in using a hemostat with long handles it cannot be opened well enough to grasp a larger object; hence in this instrument the lock has been shifted further toward the center of gravity to permit the jaws to be separated widely. Such a clamp may be applied to a bleeding point high up in the bowel and left in place after the removal of the sigmoidoscope. Of course the possibility of a severe hemorrhage, whether the cold snare or a high frequency cutting current is used, can never be excluded; hence the need of clamping the bleeding vessel. Such an instrument may find a further field of usefulness in the bleeding which may occur when a piece of tissue is excised for diagnostic purposes.

SUMMARY

1. Certain growths of the sigmoid are removable by the rectal route.

2. Spinal anesthesia is desirable.

3. Tumors of the posterior wall become more accessible in the knee—chest position.

4. When a growth cannot be reached because of a kink or angulation lift up and straighten the gut with a cotton pad on long forceps.

5. Control postoperative bleeding by special clamp.

"CHIMS" (COPPER NEEDLES)

AS A THERAPEUTIC MEASURE

(A METHOD OF THE "OLD" SCHOOL OF MEDICINE IN KOREA)*

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OF the therapeutic methods practiced for centuries by Koreans one still survives which is of uncommon interest. This is the introduction bodily of copper needles (called "chims" in Korea) into the abdominal cavity. Though the practice still survives, it seems to be dying out, or at least is used only rarely today. I have seen only 6 cases during twenty years of practice in Korea. Four of these were discovered incidentally; only two patients volunteered the information and connected present symptoms with the presence of the needles.

The use of "chims," or needling, as ordinarily practiced is a common method of the "old school." Ordinarily the needle is introduced into the tissues and withdrawn. The indication for such needling is swelling or pain, or both. The most common location is the joints, but very few regions are exempt.

The introduction of copper needles through the abdominal wall to be left in the abdominal cavity is rather a startling procedure and must call for heroism on the part of the patient. The needles are quite blunt at both ends and measure about 2 cm. to 10 cm. in length. In caliber they are about the thickness of the lead refills commonly used in lead pencils nowadays. They are not heated, and no antiseptic measure is used on needles, patient or doctor's hands, except that the "doctor" may wipe off the needle on his hair before proceeding with the operation! There is no special instrument available for the operation; these blunt needles are driven through by main force with a rotating motion. Two or three are introduced at one sitting, and the procedure is repeated after a week or more as indicated. In 1 case as many as 60 needles had been introduced into the abdominal cavity in this way over a period of several years.

FIG. 1.

In the case illustrated by the accompanying roentgenogram the patient came for symptoms of indigestion. He had very little pain and was quite sure that his present symptoms were not due to the needles in his abdomen. He said that he had "a little distress for two or three days after the introduction of the needles, after which he felt better." The needling had been begun eight years previously and 2 or 3 introduced at a sitting, a total of 34 over a period of four years. They were not mentioned by him in the clinic, being discovered by us during a fluoroscopic

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examination of the gastrointestinal tract. The roentgenogram shows 34 needles in a variety of sizes. The most amazing finding, readily seen in stereoscope, is the presence of 8 or 10 neeedles in the bodies of the lumbar vertebrae, partially covered in by a massive hypertrophic spondylitis. The presence of these foreign bodies has produced a marked thickening and fusion of the bodies of the vertebrae.

This patient was not operated on, but 3 others have had laparotomy performed. The striking feature in all these was the scarcity of gross pathology. There were no adhesions or kinks, the intestines were free and the needles were imbedded in scar tissue in the omentum and mesentery. Locally even there was so little thickening that the needles were hard to locate.

The outstanding facts in these cases are the absence of acute peritonitis in spite of the lack of antiseptic measures, and the absence of embarrassment to the abdominal organs in spite of the presence of these foreign bodies.

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VASCULAR DISEASES OF THE EXTREMITIES

IV. THROMBOANGIITIS OBLITERANS*

A REVIEW

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THROMBOANGIITIS obliterans was first described in 1856 by Charcot, but its actual recognition, clinically, dates from the report of a case by Winiwater in 1879. Being unfamiliar with the histopathology in the various stages of the disease, he incorrectly named it endarteritis obliterans. This term is still used by modern authors as are also the non-descriptive, presenile gangrene, Buerger's disease, and many others. It was in 1908 that Leo Buerger, after an exhaustive study, established the disease as a definite clinical and pathological entity and properly termed it thromboangiitis obliterans, which is a no less complete definition than is that one usually given in a few brief introductory sentences.

ETIOLOGY

The cause of this occlusive thrombotic process is as yet unknown, but a microbial agent seems to be the most probable one, because in the involved vessels, early in the process of healing, there occurs an inflammatory lesion which shows a specific and characteristic morphological picture, and in the acute stage certain purulent foci are usually in evidence.

Syphilis was once thought of as a cause, but as positive Wassermann reactions are present in less than 10 per cent of the reported cases, one may assume that its existence is merely a coincidence.

CONTRIBUTORY ETIOLOGIC FACTORS

Buerger contended that the disease rarely attacks other than the Semitic male, especially those of Russian origin. Of 500 patients observed by him, only 10 were Gentiles. Of this number, only 3 were females and in these the diagnoses were merely clinical ones. From a review of the more recent reports it is evident that the disease occurs more commonly in the Hebrews than in other peoples. Allen and Brown of the Mayo Clinic report that 50 per cent of their 200 cases were Jews, the remaining 50 per cent being Austrians, Finns, Norwegians, Germans, Scots, Irish, French, English, Dutch, Greeks, native Americans, and those of mixed ancestry. It has been reported in Swedes by A. J. Ochsner, in Koreans by Ludlow, in Turks by Wieting, in Norwegians by Timme, and a questionable case has been recorded by Gemmill in a negro. Whyte has observed the disease in the Chinese, and Meleney and Miller reported 24 cases in this race, one of which was a woman. By means of a questionnaire, they determined that out of 119 physicians, 51 had observed thromboangiitis obliterans in the Chinese. Ito reported it as occurring among the Japanese, and Koyana collected 120 cases occurring in this race. Tilford and Stopford reported 2 typical cases occurring in English females. Jablons observed 1 case in a female and confirmed his diagnosis microscopically. Idelsohn reported that out of 136 cases, which occurred in the Baltic provinces, only 60 per cent were Jews. Thus, it is evident that the disease is almost completely sex limited, but that its geographical and racial distribution is quite widespread. There is no proof that heredity plays an important etiological rôle. Because of the widespread occurrence of the disease, diet and obesity can be eliminated as possible causes. Occupation seems to be of no importance, although it is thought that exposure to cold hastens

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the appearance of the disease in those predisposed.

Allen and Brown suggest that the prostate may serve as a focus of infection, but state that the theory lacks proof as does the impression that any distant foci of infection are of etiologic significance.

Tobacco smoking has been shown to be more prevalent in patients with thromboangiitis obliterans, but one must not lose sight of the possibility that smoking might have been initiated in some cases in order to make this painful and chronic disease less unbearable. Allen and Brown found that 20 per cent of all the adult male patients at the Mayo Clinic denied the use of tobacco, whereas only 1½ per cent of those with thromboangiitis obliterans were total abstainers. One per cent of Buerger's 500 cases, 4 per cent of Jablon's 200 cases, and 10 per cent of Perla's 41 cases denied the use of tobacco; but of Meleney and Miller's series of 24 cases, 40 per cent were total abstainers. That smoking is a contributory etiologic factor seems likely, but absolute proof of this is lacking.

The age of onset of thromboangiitis, as given by Perla, is from twenty to forty-five years; Allen and Brown give the age of onset from seventeen to sixty-four years, with the highest incidence from thirty to fifty. Franenthal reported a doubtful case in a child of three. Koyano observed a patient whose symptoms began at nine years and there are several other cases recorded as occurring in the first decade of life. Buerger found the age of onset in his large series to range from seventeen to fifty-six years, with an average age of thirty-two. However, he states that these figures are much too high since it is very difficult to estimate the exact age at which the disease began, because of the insidious nature of the onset and because of the fact that it is overlooked in many cases. It must be borne in mind that remissions are common and have been known to last twenty years, that histories are inaccurate, and that a progressively increasing collateral circulation may delay the appearance of symptoms.

CLINICAL COURSE

Thromboangiitis obliterans occurs most frequently in one or more of the extremities and first manifests itself when the circulation becomes inadequate for increased or prolonged activity of the part. There are in most instances indefinite pains in the sole of one foot, in the ankle, or in the toes, or there may be sudden cramp-like pains in the calf or elsewhere in the affected extremity. Other patients may have a feeling of numbness or coldness in the feet, especially in cold or damp weather. Rest or heat may relieve these, but after weeks or years evidences of trophic disturbances are present. Following trauma or without apparent cause, an abraded spot or hemorrhagic bleb, a pustule, or a dry, dead patch of skin develops near the tip of the toe or under a nail. Now the pain becomes excruciating even in inactivity, as during the night.

It is during the stage of trophic disorders, or probably only when intermittent claudication is present that the characteristic blush of the toes and foot is observed when the part is in the dependent position. At first this blush, or bright red hue is noted in the affected toe, but it spreads rapidly to the others and may even extend above the ankle. This symptom is referred to infrequently as erythromelia. On elevation of the affected part, a true ischemia rapidly develops. Conservative treatment may result in a remission or the symptoms may persist. The dorsalis pedis and post-tibial arteries now usually fail to pulsate, and the erythromelia and ischemia may be elicited at will. Ultimately, with or without treatment, gangrene develops, the pain becomes unbearable, and not infrequently a superficial thrombophlebitis makes its appearance.

CLINICAL TYPES

Some of the more common clinical types are as follows:

1. Those with pain or intermittent claudication and rubor, but without trophic lesions.

2. Those who have had vague symptoms, but on examination are found to have definite evidence of the disease.

3. Those who have ignored symptoms, but seek advice for trophic disturbances.

4. Those who seek advice for symptoms in one extremity, but are found to have had it for sometime in another.

5. Those in whom the disease is running an orderly and rapid course.

6. Those who are apparently cured or are in a stage of remission.

7. Those running a slow but progressive course.

8. Those in whom both upper and lower extremities are involved.

9. Those presenting with gangrene and running a fulminating course.

Sites of lesions

Of Buerger's 100 cases, there were 171 lower extremities involved, and when one alone was affected, the left was involved three times more frequently than the right. Of the upper extremities, in 21 cases, the arms were involved thirty times, the left being affected in 7, and the right alone in 5. Twenty-one cases showed involvement of upper and lower extremities. All four were affected in 8 cases; 2 lower and 1 upper in 10 cases; 2 upper and 1 lower in 1 case; 1 upper and 1 lower in 2 cases. Koyano, in a series of 125 cases, found associated involvement of upper and lower extremities in 30 per cent.

Allen and Brown found little difference in the frequency of involvement in the right and left extremities. The frequency of involvement of the arteries they state as follows: the dorsalis pedis, post-tibial, popliteal, and femoral in the lower extremities, and the ulnar and radial in the upper extremities.

Buerger has observed what he terms the acute lesions in territories other than the vessels of the extremities; namely, in the spermatic artery, in the veins of the spermatic cord, and old lesions were found in one of the branches of the gastric artery in a case of ulcer of the stomach. Spiegel reported an authentic case with involvement of the mesenteric vessels. Meyer reported a case in which an operation was performed for symptoms of intestinal obstruction in a man suffering with thromboangiitis obliterans. At operation the mesenteric vessels, as well as the iliacs, were found markedly thickened and sclerotic. Unfortunately, a microscopic examination was not made. McGregor and Sims reported a case in which the spermatic vessels were involved. Linenthal and Barron believe that the disease may occur anywhere in the vascular system and suggest that symptoms of angina pectoris in early life may be due to thromboangiitis obliterans. That arteriosclerosis may develop centrally in those affected with thromboangiitis obliterans, is well known, and it is likely that the development of this process may obscure a once present typical lesion of thromboangiitis obliterans.

Lemann deplores the fact that up through 1928 there had been only 6 autopsies performed on patients who were definitely known to have had thromboangiitis obliterans. Buerger reported 4 of them and found coronary arteriosclerosis in one, thromboangiitis obliterans of the coronary vessels in another, and central arteriosclerosis with bland thrombosis in two. Perla reports that he found the typical lesion of thromboangiitis obliterans in the coronary vessels of one of his cases. Lemann's autopsy was the sixth, and this was on an elderly patient who had suffered for many years with thromboangiitis obliterans of the extremities. The coronary vessels showed advanced arteriosclerosis with occlusion.

Symptomatology

Allen and Brown state that pain of claudication was the first symptom in 51 per cent of their cases, the longest history being fifteen years and the shortest two months. Coldness of the extremities was

the first symptom in 12 per cent; abnormal fatigue in 11 per cent; non-healing ulcer in 10 per cent; sudden arterial occlusion in 7 per cent; recurrent superficial phlebitis in 4 per cent; edema in 3 per cent, and vasomotor disturbances of the spastic type in 2 per cent.

The disease manifests itself in the early stages in different ways. Most patients give a history of fleeting, indefinite pains in the foot or toes. Others may be conscious only of the toes or foot becoming cold and numb in cold or inclement weather. Frequently, cramp-like pains may occur in the calf muscles when walking. This is the characteristic pain of intermittent claudication, which at first is relieved by rest, but later becomes more constant as collateral circulation begins to fail. Some few patients may give a history of pain and tenderness, with redness at times over the superficial veins of the extremity, which is due to the migrating thrombophlebitis stressed by Buerger, who claims that it occurs in 25 per cent of cases. Its occurrence, if not pathognomonic in itself, affords an opportunity for study of the characteristic lesions.

These symptoms are characteristic of the early stages of the disease and may persist for weeks, months, or even years, followed by a series of trophic changes or gangrene. The most common sites for ulcerations are on the outer or inner margin of the big toe adjacent to the nail, the outer aspect of the little toe, the middle of the second toe, the middle of the dorsum of the foot, the inner aspect of the ankle inferior to the internal malleolus, and on the anterior aspect of the leg over the tibia. The slightest trauma may be sufficient to produce these changes. Frequently they arise spontaneously from infarcts being preceded or accompanied by increased and persistent pain which is not relieved by rest. Pain may be considered as an index of the degree of vascular obliteration.

At any stage of the disease a new and characteristic sign may make its appearance. This is the erythromelia or peculiar blush which begins in the affected toe or toes and then gradually extends up the dorsum of the foot and sometimes to a short distance above the malleoli. It is best observed with the foot in the dependent position. The characteristic ischemia when the extremity is raised above the horizontal position also may be elicited.

Palpation will reveal at this stage a loss of pulsation in the dorsalis pedis, posterior tibial, possibly popliteal, or even the femoral arteries. The surface temperature of the part is markedly lowered especially when ischemia is produced. Both lower extremities are likely to show these changes, but if only one is involved the contrast between the two is marked.

If ulcerations are present, these are frequently infected, as evidenced by the accompanying lymphangitis or cellulitis with edema.

A later examination reveals localized or spreading gangrene, and frequently the patient pleads for an amputation in order to rid himself of excruciating pain which morphine has not relieved.

PATHOLOGY

The characteristic thrombotic lesions which are consistently seen in the deep and larger arteries and veins and occasionally in the superficial veins, may be divided into the acute and healed stages for purposes of study. At the time of amputation we only expect to encounter the healed lesions unless migratory thrombophlebitis is present.

The healed vessel grossly appears to be filled with a grayish or yellowish mass that can be differentiated from the intima and shows one or more fine openings through which a minute drop of blood can be squeezed. The vessel wall itself is usually contracted so that it appears thickened. If the lesion is old enough there may be some accompanying arteriosclerosis which partially obscures the original picture. Characteristically there is a marked periarteritis which binds together accompany-

ing nerves and other vessels which may present the disease in a different stage.

Microscopically the occluding mass is seen to be organized tissue rich in canalizing vessels about which there may be a sparse amount of elastic tissue. The intima which can readily be differentiated, is merely thickened by contraction and shows infiltration of new vessels which penetrate to the occluding tissue. Unless the lesion is a very old one or has occurred in old age, there is no splitting and reduplication of the interval elastic lamina which is characteristic of arteriosclerosis. This important differential point is strikingly demonstrated with an elastic tissue stain. The media appears atrophied and infiltrated with new vessels some of which penetrate toward the old thrombus. The adventitial coat shows a characteristic fibrous tissue proliferation which indicates that it has been the seat of inflammation and serves to differentiate the whole lesion from one of arteriosclerosis.

On tracing out the occluding tissue we find that it extends upward to end in a practically healthy vessel wall as a rounded or convex projection, or it may be capped by an additional more recent red or brown thrombus which rises in pyramidal fashion.

The acute lesion is striking and pathognomonic, but the opportunity for observing it rarely presents itself.

Grossly the vessel wall appears thickened and red and within it is a recent red or brown soft thrombus.

Histologically the earliest changes are those of an acute inflammatory process involving all coats of the vessel. The intima, the media, the adventitia and perivascular tissues are infiltrated with polymorphonuclear leucocytes and the lumen of the vessel is completely filled with red clots. In the peripheral portions of the thrombus, large or small foci of leucocytes (purulent foci) begin to form. The remaining portions of the clot show an infiltration of leucocytes; but this may be seen undergoing organization while the purulent foci develop into the typical giant cell foci, containing giant cells, endothelioid or angioblasts, and broken down leucocytes. Ultimately, these foci undergo organization. The giant cells disappear and new vessels penetrate, the final product being a fibrous nodule containing vessels and some pigment.

In the media the muscle fibers are split by the leucocytic infiltration which ultimately disappears to be replaced by newly formed vessels some of which penetrate the clot.

The adventitia also shows a leucocytic infiltration which later gives way to a fibrous tissue proliferation.

In short, the lesions in thromboangiitis obliterans are, in chronological order, an acute inflammatory lesion with occlusive thrombosis, the formation of miliary giant cell foci, the stage of organization with the disappearance of the miliary giant cell foci, the organization and canalization of the clot, the disappearance of the inflammatory products, and the development of fibrotic tissue in the adventitia, that binds together the artery, vein and nerves.

When the lesion has existed for many years, a secondary thickening of the intima takes place with corresponding proliferation of elastic fibers that must not be confused with arteriosclerotic processes.

It is true that etherosclerotic plaques in which the elastic fibers are arranged more or less parallel with the internal elastica lamina, may encroach upon the lumen of the vessel because the two diseases may be associated. It must be admitted that a predisposition to vascular disease, as it manifests itself in certain cases, seems to express itself both in a susceptibility to thrombotic lesions as well as to degenerative ones. Autopsy findings in cases of thromboangiitis obliterans show that the more centrally situated arteries develop a tendency to arteriosclerotic lesions even though the arteries of the extremities show but little sclerosis.

That the accompanying nerve may be

included in the periarterial fibrosis has been mentioned. In addition, the nutrient blood vessels supplying the nerve may be affected. Meleney and Miller report that all of their cases with pain showed this nutrient vessel occluded. This may also account for some of the trophic changes which accompany the disease. Changes in the nutrient vessel supplying the bones have not been described although roentgenograms show an accompanying rarefaction and decalcification, particularly in cases where gangrene is impending or has already developed. However, in localized gangrene of the toe, the bone may be entirely unchanged in spite of the extensive necrosis of the tissues surrounding it.

There are no characteristic changes in the muscles, although in long-standing cases atrophy occurs due to impaired circulation.

The interference with the blood supply and the involvement of nerves give rise to changes in the skin and skin appendages. Thickening, hyperkeratosis, and scaling are frequently seen. Alopecia may occur, and the nails show changes varying from mild ridging to marked hyperplasia with deformation and incurvation. Ulcers commonly develop under the nail bed, over the tibia, on the plantar surface of toes, or immediately below the malleoli.

When the occlusive thrombotic process becomes too extensive for the collateral circulation to compensate, gangrene of the infarct type develops and spreads with the extension of the thrombosis and the inevitable infection.

Willy Meyer reported a series of 34 cases in which the average red blood cell count was over 5,000,000, and the hemoglobin about 95 per cent. Jablons states that there were only occasional variations from the normal values in his series. Thomas and Christianson have reported cases in which a leucocytosis persisted, but studies of the white blood cells by Jablons showed that 72 per cent of 36 cases had a leucocyte count of between 5000 and 10,000. Allen and Brown found white and red blood counts normal in their large series.

DIFFERENTIAL DIAGNOSIS

The first distinction to be made is that between an organic or occlusive vascular disease and a functional or vasomotor disease. This can be done in most cases by repeatedly determining the state of pulsation in the peripheral vessels. It is in eliciting this that the Pachon oscillometer will often prove a valuable aid and rarely obviate an error in diagnosis in case of an anomalously coursing vessel. Raynaud's disease is characterized by a sudden onset with local syncope or regional ischemia involving the fingers more rarely the toes, and occasionally the ears and nose, short duration of the sensory and vascular manifestations and their intermittent character, symmetrical gangrene, and absence of arterial occlusion. This disease characteristically attacks the young female, whereas thromboangiitis obliterans is of doubtful occurrence except in the male.

Acrocyanosis, a progressive, slowly developing asphyxia of the ends of the extremities, with local hyperesthesia is generally associated with pulmonary osteoarthropathy.

In erythromelalgia, there is a chronic localized hyperemia with pain and swelling when the feet are dependent. The attacks are relieved by elevation of the part and the application of cold. Ischemia does not occur.

Sclerodactylia and scleroderma are generally symmetrical and though they may present vasomotor signs of asphyxia and syncope, they are characterized by shortening of the fingers due either to a contraction of the skin or absorption of the terminal phalanges, which can be recognized roentgenologically. The differentiation of thromboangiitis obliterans from arteriosclerosis with occlusion is not always readily made.

In arteriosclerotic endarteritis obliterans, with or without diabetes mellitus, the age of the patient is usually over fifty; vasomotor phenomena are infrequent; gan-

grene, which may be of the moist type, supervenes earlier after the first symptoms and progresses more rapidly; the physical manifestations of impaired circulation are few prior to the onset of gangrene; pain is less marked; migrating phlebitis does not occur, but marked varicosities of the superficial veins are more frequent. It is seldom found in the upper extremities. Its presence is readily demonstrated by roentgenograms.

The early diagnosis of thromboangiitis obliterans is most essential from a therapeutic standpoint. This is usually simple, but at times may be made only on age of the patient, sex, excessive pain, or the occurrence of a migrating thrombophlebitis.

PROGNOSIS

Perla gives the average life of limb in his series as one to two years after onset, but he had one case in which the duration of the disease was twenty years. Two of his patients had remissions of fifteen years, and 9 of them were symptom-free from three to five years.

Buerger had one patient in whom gangrene did not occur until twelve years after onset of the disease; also many in whom there were remissions of variable periods; but, nevertheless, he gives a rather gloomy prognosis as to life of the affected extremity. Other authors have given an equally unfavorable prognosis; but from reports in the more recent literature, one is led to conclude that either the disease is more chronic and more slowly progressive than was formerly thought, or that conservative therapy is of distinct value.

Allen and Brown conclude that "thromboangiitis obliterans is apparently a self-limiting disease, as the obliterative process eventually stops." On consideration of the clinical course, it becomes evident that there is a simultaneous arterial obliteration and reestablishment of circulation both in the old thrombi and in the newly developing collateral channels. Trophic changes, as gangrene and ulcers, occur as obliteration progresses. Amputation seems inevitable and is necessary at times; but frequently, as the compensatory circulation increases and becomes established to a high degree, the trophic changes disappear, and the patient may be symptom-free for years or perhaps indefinitely.

Trophic changes accompanied by severe pain, even when at rest, or infection with edema usually progress to extensive gangrene requiring amputation.

The economic factor greatly influences the prognosis. Patients who cannot afford long periods of rest with institution of conservative measures, usually require high amputation performed early. However, patients in whom the condition is diagnosed early and who cooperate with a physician in an attempt to establish collateral circulation may expect either a low amputation or perhaps a useful extremity for years or even for life.

TREATMENT

Multiplicity of therapeutic measures advocated for a given disease indicates that no one is entirely satisfactory, and usually that none of them strikes directly at the predominating etiological factor. This is the case in thromboangiitis obliterans, but at least progress is being made toward conservatism.

The stage of the disease should determine the treatment. Four stages may be recognized:

1. Extensive gangrene with or without pain. The treatment is high amputation.

2. Severe "rest pain" with or without moderate trophic changes. The treatment consists of measures for relief of pain, methods to increase circulation, removal of foci of infection, and, in a limited number of cases, lumbar ganglionectomy and rami section may relieve pain and increase circulation. If these measures fail, amputation is indicated.

3. Mild trophic changes without "rest pain." The treatment should be designed to increase circulation. Foci of infection

should be removed and prolonged rest enforced. Lumbar ganglionectomy and rami section are of value in certain cases.

4. Neither "rest pain" nor trophic changes. The treatment consists of rest, removal of foci of infection and conservative measures to increase circulation.

Cessation of smoking is indicated in all cases as its vasoconstricting action prevents a maximum development of collateral circulation. The removal of foci of infection is advisable in all cases to improve the general condition of the patient.

Avoidance of excessive exercise, wearing of tight shoes, exposure, and trauma are indicated to lessen the occurrence of trophic changes.

Means for increasing circulation are numerous and may be grouped as follows:

1. Physical means. Heat in various forms is of benefit. It may be administered by baking, diathermy, heat tents, and other means, but is probably most efficacious when administered as hot sitz baths. Contrast baths produce a vaso-dilating effect; but cold if continued too long is dangerous in these cases, and is, therefore, contraindicated.

2. Mechanical measures include Buerger's postural exercises, which are of definite benefit in the young, but are too exhausting for elderly people. With the patient lying in bed, the affected extremity is elevated to from 60 to 90° above the horizontal, allowing the part to rest upon a support for from thirty seconds to three minutes in order to produce ischemia. As soon as blanching occurs the patient then hangs the leg down over the edge of the bed long enough for the characteristic rubor to set in. The limb is then placed in the horizontal position for three to five minutes, during which time heat should be applied. This procedure should be repeated for one hour, as many times a day as seems practicable. Hyperemia, induced according to the method of Bier, is another method included in this group.

3. Measures affecting the vasomotor system include the use of vasodilating drugs, such as nitroglycerin and the nitrites, which are of doubtful value. The administration of typhoid vaccine to induce fever and a vasodilating action in the collateral channels of the diseased extremity have been shown by Brown and Allen to be of distinct value. These observers have demonstrated by calorimetric methods that during the fever there is a distinct increase in blood flow through the affected extremity. Goodman and Gottesman suggested the use of typhoid vaccine intravenously for induction of fever. The initial injection should contain 40,000,000 killed organisms and should be repeated five times at daily intervals in doses which are increased sufficiently to produce a chill and a 2 to 4° elevation of temperature. Although exhaustive in repeated courses, its beneficial effect on pain and trophic changes warrant its use within conservative limits in practically all cases.

4. Measures designed to affect the blood directly, include the administration of various solutions as infusions and clyses.

Koga in 1913, hoping to decrease the blood viscosity, advocated hypodermoclyses of Ringer's solution. This method immediately became popular and various modifications of it are still being used with presumably favorable results.

Steel advocated the use of sodium citrate in Ringer's solution intravenously, reasoning that clotting would be decreased. Buerger states that the results obtained by this therapy hardly warranted its use. However, Jablons reports favorable results from the employment of an elaborately prepared citrate solution. Twenty grains of sodium citrate are dissolved in 100 c.c. of freshly prepared doubly distilled water to which 3 gm. of sodium chloride are added. The addition of 1 gm. of dibasic potassium phosphate is usually required to render the solution iso-electric as well as isotonic. This latter acts as an anticoagulant, and when present in certain concentrations, prevents the occurrence of the severe chills which follow the use of sodium citrate in distilled water. The

solution is filtered and sterilized in an autoclave. Two hundred fifty cubic centimeters of the solution are administered intravenously every day for ten days, and then given at two-day intervals for a period of six months. After this, improvement usually warrants an interval of a week for the next year. Of Jablons' 120 patients treated in this way for one to three years, 60 have been symptom-free.

Willy Meyer claimed beneficial results after flushing the intestinal tract daily with 8 to 10 qt. of Ringer's solution through a duodenal tube and supplementing this with daily hypodermoclyses of the same solution. Allen and Brown have used radium chloride intravenously and have found that it relieved pain in 70 per cent of cases. However, they found it to be an expensive procedure and no more efficacious than the administration of typhoid vaccine.

At Mount Sinai Hospital, in New York, Silbert and Samuels have reduced the percentage of amputations from 77 per cent to 10 per cent by the intravenous administration of hypertonic salt solution. Three hundred cubic centimeters of 5 per cent sodium chloride solution are given three times a week over a long period of time. Of 84 cases so treated by Silbert, only 12 per cent have required amputations in four years.

5. Surgical procedures on the vessels in a large series of cases have been reviewed by Etto and Stelton, who reported failures in over 70 per cent of cases. These procedures are ligation of the femoral vein, as advocated by Oppel, Morton and Lilienthal, and arteriovenous anastomosis, as practiced by Weiting, Goodman, Satrustegen and Davies.

Ligation of the femoral artery as practiced by Lewis and Reichert in arteriosclerosis, hardly seems a rational procedure to institute in a disease which itself occludes the arteries.

Since Pearse has shown experimentally that simultaneous ligation of the artery and vein results in improved circulation peripherally, it seems that vein ligation in this disease should produce like results. Pearse and Morton have utilized this procedure for some time and report gratifying results from it. Van Gorder, in Peking, reports that of 9 patients so treated eight were improved or actually relieved of their gangrene.

6. Measures to lessen pain are numerous. Although any procedure which increases circulation lessens pain, it has seemed important to obtain immediate relief. Analgesic drugs give only partial relief, and morphia for obvious reasons is undesirable.

White and Smithwick inject alcohol into the anterior and posterior tibial nerves and the lateral cutaneous branch of the peroneal nerve. Also 6 inches above the ankle between the tibia and fibula the medial cutaneous branch of the peroneal nerve may be exposed and injected. If the anterior and posterior tibials are injected in their lower thirds only, the intrinsic muscles of the foot are affected and gait is only slightly disturbed. This procedure affords relief for six weeks and allows improvement in that necrotic areas may be attended to without inducing pain. This measure does seem of value but no doubt ulceration may occur at the site of injection.

7. Local treatment. Trophic ulcers are treated on general surgical principles. For local pain Buerger suggests the use of an analgesic ointment containing 5 per cent novocaine and 10 per cent orthoform or anesthesin in lanolin and glycerine. Migrating phlebitis is best treated by application of hot wet dressings.

8. Surgery of the sympathetics. Adson and Brown have shown that lumbar ganglionectomy and ramisectomy produce definite and persistent vasodilatation of the vessels of the feet when vascular dilatation is obtainable.

In thromboangiitis obliterans, in addition to occlusion, there is also a vasomotor factor which is probably due to impulses arising in inflamed vessel walls and being

carried to the spinal cord reflexly produce a vasoconstriction or prevent maximum vasodilatation. If the lumbar sympathetic chain is removed, this reflex arc is broken and there results a diminution in vascular tone and a vasodilatation permitting an increased blood flow in certain cases. Brown has determined that this procedure is applicable to only 1 out of 7 patients with thromboangiitis obliterans. He calculates their vasomotor response by giving typhoid vaccine and determines the rise of surface temperature and oral temperature. If the increase in oral temperature is subtracted from the increase in surface temperature and the result divided by increase in oral temperature, a so-called "vasomotor index" is obtained. If this index is 1.5 or more, a favorable result may be expected from lumbar ganglionectomy and ramisectomy.

Periarterial sympathectomy, as originally advocated by Leriche, has given uncertain results and is seldom practiced. Bernheim terms it "a tiding over process," which should be used in selected cases as it frequently relieves pain and is easy to execute.

9. Roentgen-ray therapy. Philips reports relief of pain and improvement of circulation in cases of thromboangiitis obliterans subjected to radiation of the lumbar segments of the spine. Beall and Jagoda report an apparent cure following such therapy.

10. Surgery of the extremities. Formerly high amputations of the extremities were performed early in the disease without due regard for the state of the circulation. However, with the advent of conservatism, one finds that indication for amputations are not clearly defined. Cases are being reported in which medical treatment has reestablished function in an involved extremity. Gangrenous lesions have been seen to heal, and Mills reports that function remains in the feet of stoic Chinamen whose toes have undergone autoamputation. To generalize, one might say that cases in which gangrene is limited to the toes should be treated medically, provided that pain can be relieved and economic conditions permit it. Those treated surgically should have the benefit of postoperative medical treatment to facilitate healing.

Incision of toes and removal of toe nails usually result in spreading gangrene and therefore should never be practiced. The level at which amputation should be performed can be determined only after an investigation of the status of the circulation. If in an attempt low amputation, vessels are found diseased, a higher level should immediately be tried rather than re-amputation at a later date. However, Allen and Brown state that amputation below the knee is successful in 80 per cent of all cases of thromboangiitis obliterans, regardless of the condition of the pulsations in the popliteal artery, provided that the gangrene does not involve the leg and extensive lymphangitis or edema is not present. They also add that combined intensive medical treatment has made possible such results.

Fingers can usually be amputated successfully regardless of obliteration of ulnar or radial arteries. Toes may be successfully amputated in that small group of cases in which either one or both of the main vessels of the foot are pulsating normally. Amputation of the distal half of the foot or above the ankle offers no functional advantage. Amputation below the knee joint offers a distinct functional advantage and is successful when popliteal vessels are patent. If the latter are occluded, amputation should be done above the knee unless medical treatment can be properly instituted.

[*For References see p.* 488.]

VISUALIZATION OF THE BILE DUCTS

FOLLOWING THE ADMINISTRATION OF A BARIUM MEAL*

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A REVIEW of the literature to date reveals that no more than 10 cases have been reported showing barium in the biliary ducts as seen roentgenographically, following the administration of a barium meal. In addition to these reports 3 other cases have been incidentally mentioned in papers dealing with other phases of the roentgenological examination of the gastrointestinal tract by the contrast method. Recently we have observed 2 such cases, the first in our fifteen years of experience, and this, together with the scarcity of the literature on the subject, leads us to believe that the phenomenon is by no means a common one.

Kantor and Jaffin[1] give a comprehensive review of the 7 cases reported up to January 1928, and add 2 more of their own. Their first case showed a thin stream of barium radiating upward from a markedly deformed duodenal bulb, apparently through a fistula formed by rupture of a penetrating ulcer into the bile duct. The patient had had an operation ten years previously, at which time adhesions involving the hepatic flexure, duodenum, and cecocolon, were separated, and the appendix was removed. Seven months later a cecopexy was performed on a large pendant cecum, and adhesions which were found in this region were separated.

Their second case showed a free filling of the biliary ducts well into the liver substance, and, based on the history was thought to be due to a spontaneous choledochoduodenostomy, probably of eighteen years' standing. In neither case was the gall bladder outlined.

Swalm and Manges[2] give a very complete report of a case which they have observed, where the gall bladder had been removed, and a choledochoduodenostomy performed. During a gastrointestinal examination barium passed into the biliary ducts and down into what appeared to be the common duct, where it was arrested at the occluded lower end, and where it remained as a residue for twenty-four hours.

Harding[3] in reporting "A roentgen study of the lesions of the stomach and duodenum, etc.," mentions a case of duodenal ulcer which had perforated into the gall bladder, and through the resulting fistula barium passed readily into the biliary ducts during a gastric roentgenological examination. The presence of the fistula was verified at operation.

Johannesson[4] mentions 2 cases where there was regurgitation of barium into the common duct. One case at operation revealed a chronic cholecystitis, and a stone the size of a pigeon's egg located in the common duct. The other showed a chronic cholecystitis, with a large thick common duct, with no evidence of stone. Apparently in neither case was a fistula present.

We wish to submit our reports of 2 additional cases.

CASE 1. A man, aged fifty-nine, was admitted to the hospital April 15, 1930, complaining of discomfort across the upper abdomen, and of precordial pain which radiated down the arms, particularly the left. Eighteen years ago an incision was made over the gall bladder and the abdomen opened, but on account of the presence of adhesions, or the discovery of other pathology, the wound was closed without further surgical interference, and on the following day a gastroenterostomy was performed. The reason for either operation could not be determined from the history.

For the last few years the patient had had considerable pain and discomfort in the upper abdomen, which had become more severe during the last three months. The pain had

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been fairly constant, and was not particularly affected by the ingestion of food. He also had severe attacks of dyspnea accompanied by

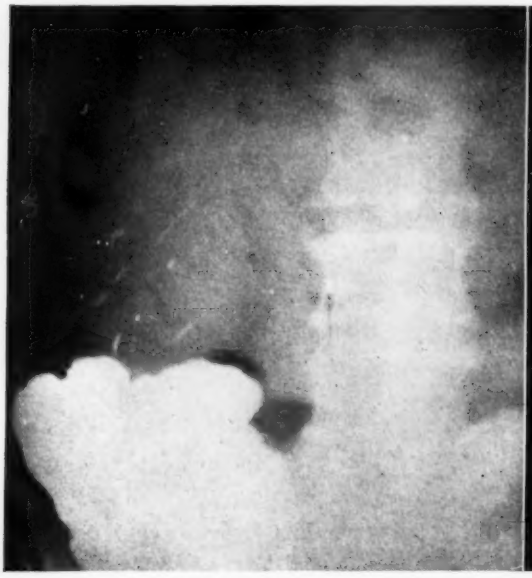

FIG. 1. Barium in biliary ducts following barium meal.

FIG. 2. Dilated ampulla of Vater. Barium filling common duct and extending upward beyond bifurcation.

precordial pain radiating to the shoulders and down the arms, and lasting about one-half hour, which occurred at infrequent intervals, and did not appear to be related to the abdominal distress.

Physical Examination: The abdomen was tender in the region of the scar over the gall bladder, and below the scar an indistinct mass could be palpated suggesting an abundance of scar tissue. At the upper portion of the second scar to the left of the midline was a small ventral hernia.

The heart was regular in rate and rhythm, and did not appear to be enlarged. The heart sounds, however, were rather indistinct. No adventitious sounds could be elicited. The pulse was of good quality. Occasional moist râles were heard over the chest posteriorly. There was a fistulous tract in the region of the anus which was draining slightly. The temperature, pulse, and respirations were normal on admission. The blood count showed 4,410,000 red cells, 14,100 white cells, and the hemoglobin was 82 per cent. The urine was negative except for a few pus cells.

On April 17 we made a roentgenological examination of the gastrointestinal tract. Both the heart and the aorta were increased in their transverse diameters, the posterior mediastinum was clear; the excursions of the diaphragm were normal. The esophagus showed no pathology. The stomach was normal in size, shape, and position. There was a gastroenterostomy on the greater curvature of the pars media, which was functioning normally and was freely movable, and which was not tender on palpation. The liver shadow was somewhat enlarged. The duodenal bulb was fixed to the under surface of the liver, and the apex of the bulb was irregular. Practically no barium could be identified passing from the duodenal bulb through the afferent loop of the enterostomy. Fluoroscopically, a narrow tract of barium leading from the deformed bulb up towards the liver, could be seen, and in the films barium could be identified high in the right upper quadrant outlining some of the biliary ducts (Fig. 1). The colon was negative.

On April 21 after the administration of tetraiodlophenolphthalein by the oral method, it was found that none of the dye had entered the gall bladder. In the gall bladder films some of the biliary ducts were still outlined by the barium remaining therein, four days after the administration of the barium meal.

During these days in the hospital the patient was comparatively comfortable, complaining only of some weakness and slight pain in the upper abdomen. The leucocyte count varied between 11,000 and 14,000, and the urine at times showed a small amount of albumin and

bacteria. The temperature, pulse, and respirations remained normal, and there were no anginal attacks since admission.

On April 24 the abdomen was opened through a gall-bladder incision. The stomach was found to be pulled over to the right and fastened by adhesions to the former gall-bladder incision. The omentum was firmly attached to the peritoneum in this area. The gall bladder was exposed by dissecting through the adhesions which were firmly fixed to the liver and duodenum. A fistulous tract about 1 cm. long was found extending from the second part of the duodenum to the middle of the gall bladder. This was severed and the stump on the duodenal side inverted. The gall bladder was dissected free and removed. No stones were found. The gall bladder measured 2½ in. in length, and ¾ in. in diameter. The walls were very thick, and the bile contained therein was thick and dark.

Four days after the operation the patient began to have a recurrence of the anginal pains and there was evidence of a slow fibrillation of the heart. During the next few days these attacks became more frequent and severe and the auricular fibrillation more pronounced. Pericardial friction could be heard. Bile was flowing satisfactorily from the drain. On the eleventh day following the operation the patient died as a result of an acute coronary thrombosis. A post-mortem examination was not made.

Case II. Unfortunately a complete record of the history and physical examination of this patient are not available as she was not admitted to the hospital.

A woman aged fifty-three, had a cholecystostomy seventeen years ago, and subsequently underwent further operations, including appendectomy, öophorectomy, and removal of stones from the pancreas. Four years previous to the present examination she gave a history of an attack of jaundice, and her recent complaint was that of pain low down on the right side of the abdomen.

Roentgenological examination showed the heart and aorta to be within normal limits. The posterior mediastinum was clear. The esophagus showed no pathology. The stomach was hypertonic; no filling defects were evident on either curvature. The pyloric antrum was normal. The duodenal bulb showed no pathology. During the fluoroscopic examination there appeared to be an extraluminal shadow in the region of the second part of the duodenum which had the appearance of a diverticulum. The film (Fig. 2), however, showed this to be a dilated common duct which had filled with barium, and which extended to the left from the descending portion of the second part of the duodenum and then upward behind the proximal horizontal portion of the second part of the duodenum into the hepatic duct. The latter could be seen to bifurcate into ducts of equal size, and these, in turn, to split up and distribute themselves throughout the liver shadow. No shadow corresponding to the gall bladder could be identified. From the films it appeared that the barium entered the common duct through a dilated ampulla of Vater. The stomach was empty at the end of five hours, and in the five-hour film (Fig. 3) many of the smaller ducts scattered throughout the liver could be seen to contain barium. At the end of twenty-eight hours these ducts were practically emptied of their barium content, only a very few of the smaller ducts being outlined.

Fig. 3. Ampulla of Vater. Barium in biliary ducts filled after five hours.

This patient has not been operated since the *x*-ray examination; therefore, the findings have not been confirmed. We believe, however, that the *x*-ray findings are quite conclusive in this case.

[*For References see p. 547.*]

ACUTE GONOCOCCAL EPIDIDYMITIS

A RÉSUMÉ*

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EPIDIDYMITIS is perhaps one of the most frequent, most damaging and most important sociologically of the complications of gonococcal infection. It is the most frequent disease of the testicle. Epididymites from other bacterial etiology, tuberculosis excepted, are indistinguishable, clinically and pathologically, from those of gonococcal origin. Epididymitis has a rather high incidence, being variously estimated at from 10 per cent to 30 per cent. Wolbarst[1] believes that 5 per cent to 10 per cent is conservative, and his private records of 5000 cases of acute posterior infections show under 1 per cent. Taylor (quoted by Wolbarst) believes that 3 per cent is high. The records of the last 300 personally treated cases of gonococcal infection show an incidence of 33 cases or 9.9 per cent, 28 cases coming for treatment with the epididymitis developed and 5 cases or 0.6 per cent developed during treatment. Epididymitis is responsible for the vast majority of cases of sterility, due to occlusion of the vas.

ETIOLOGY

The causes of epididymitis are variously stated, but a careful history will generally reveal that it starts within at least twenty-four hours after the following procedures: 1. The use of a strong irritating injection, forcefully given. 2. Injury to the posterior urethra by rough, unscientific instrumentation or catheterization. 3. Hydrostatic irrigation with too forceful a pressure. 4. Too vigorous prostatic massage or rough digital manipulation of the vesicles. 5. Prolonged and repeated sexual excitement with a distended bladder or excessive sexual intercourse in the presence of an urethral infection.

Sexual excitement is only a factor when the bladder is distended. According to Pelouse[2] the main element is the increase of intraurethral and intravesical pressure, because the internal sphincter relaxes and the posterior urethra becomes virtually a part of the bladder cavity and the purulent gonococci-laden contents are subjected to great pressure, forcing them into the ejaculatory ducts. Improper massage is a very frequent cause as has been pointed out by us in previously published articles.[3,4,5]

Traumatic orchitis is indeed a misnomer, as applied to acute infections of the testicle, as has been pointed out by Wesson.[6] Epididymitis is common and orchitis is rare except as a complication of some systemic disease. A latent seminal vesiculitis and not trauma is responsible for the cases commonly and incorrectly diagnosed as traumatic orchitis. Extension would have occurred whether there had been a trauma or not. It has always been rather difficult for me to appreciate the rôle of a suspensory in preventing the spread of a urethritis to the epididymis, because we have seen patients develop this while wearing a suspensory and even while at rest in bed.

Gonococcal epididymitis may develop at any time during an acute infection, but usually develops at the height of the inflammation, but not infrequently occurs in chronic cases without apparent cause as noted in 8 of personally observed private cases. It is generally unilateral in 95 per cent of cases and more common on the left side. Double simultaneous epididymitis is quite rare; we have only seen 1 such case in nine years at The Lakeside Clinic. Subsidence in one organ with subsequent appearance in the organ on the other side is much more common. That the inflammation spreads to one side and not to the other

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may be due to the occlusion of one side by swollen mucous membrane, while the other remains patent. The clinical course is generally abrupt, gradually declining in five days under proper treatment. Death is rare, but sterility occurs in about 2 out of every 5 cases of bilateral epididymitis.

ANATOMY

Before we discuss the mechanism of epididymitis a brief review of the salient points of the anatomy will give us a clearer conception of the process. The epididymis caps the testicle, located on its upper and posterior surface. It is divided into the globus major, or head, the body, and globus minor or tail and is about 5 cm. in length. It is closely invested by the tunica vaginalis, except at the head and tail. Beginning at the head in the cornius vasculosis, a series of convoluted cones, bound together to form about twelve tubes, make up the globus major, which rests on the top of the testicle. They all join to form one single tube, which is very much coiled and twisted upon itself and is the body of the epididymis, which becomes further convoluted and forms the tail or globus minor. There is no compartment formation as at the head, but the coils are separate, but bound together at this point and united by connective tissue to the testicle. The canal is lined with ciliated epithelium and the peristaltic wave is toward the vas. The length is about 20 ft. and the diameter 4 mm.

From a clinical standpoint the tail is the most important. The junction between the body and the tail is quite irregular, the tubule here, separating out as a single tube and at this point making a number of acute angles upon itself and becoming large and thicker, meeting the vas deferens at an acute angle.

MECHANISM OF ACUTE EPIDIDYMITIS

It is only remotely possible for organisms to be carried along the lymphatics of the sheath of the vas to the epididymis; in fact, extension by this route is questionable, despite the claims of Walther.[7] That the organisms are not carried along the mucosa of the passages by continuity, as infection spreads from anterior to posterior urethra, is demonstrated by the rapidity of onset of the epididymitis, far too fast for bacterial progression, and the absence of involvement of the mucosa except at certain isolated areas. There are also anatomical and physiological reasons. The ejaculatory ducts are only 2 cm. long but the vas is 45 cm. long and the gonococci must spread all this distance against a current of fluid and the peristalsis of the vas. It is also known clinically that at least 98 per cent of the cases of epididymitis develop before a vasitis and then generally at the epididymal extremity. It is also recognized that long, narrow, mucous channels rarely become infected through continuity with the surface.

We know that peristalsis of the vas does occur during coitus and is from the vas toward the posterior urethra; but no investigation has shown that it may be in the opposite direction. The theory of reverse peristalsis has many flaws that time will not permit discussion of, except to say that the ejaculatory ducts contain no circular muscular fibers that make peristalsis possible.

Then what is the mechanism by which the epididymis becomes infected? Rolnick[8] has produced clinical as well as experimental evidence that points to the lumen of the vas as the pathway of infection. There is mechanical transference of the purulent products, gonococci-laden, from one point to another, from posterior urethra to vesicles to vas deferens to the epididymi. The vesicles must be infected before the epididymis.

The posterior urethra becomes involved during an acute urethritis and the veromontanum is involved, and thus the gonococci-laden pus is drawn in and carried up the ejaculatory ducts. When not inflamed the sphincters of the ejaculatory ducts are in a state of contraction; but when they are inflamed or mechanically

irritated or traumatized, they lose their tone and bacteria can travel up, with edema and occlusion following. The seminal vesicles which have become infected are unable to drain through the swollen and occluded ejaculatory ducts, converting the vesicles into infected retention cysts. The front door is blocked and the vesicles are overdistended and the infection spreads through the back door, the only means of egress, into the epididymis. The dull pain and aching in the groin which usually precede clinical epididymitis can be attributed to the increase tension in the vas. This generally disappears when the epididymis becomes involved, the infectious processes having locked themselves in the tail.

Fig. 1. Acute gonococcal epididymitis.

Inflammatory swelling follows the infection and occludes the tubules at the junction of the tail and vas, which, may be recalled, is an acute angle and drainage is stopped. At the junction of the upper end of the tail with the body, the upward extension of the process within the tubule becomes blocked as a result of the inflammatory swelling and the anatomical fault previously described, and the infection is locked in the tail. This accounts for the fact that gonococcal epididymitis is practically never an epididymo-orchitis, but a pure epididymitis, limited to the tail. There is little, if any, involvement of the testicle or body or head of the epididymis. Hagner[40] in a series of more than 200 cases of gonococcal epididymitis, operated upon, never found evidence of involvement in the testicle itself.

Rolnick[8] has failed repeatedly in attempting, with either low or high pressure, to force fluid beyond the tail of the epididymis, through the vas. This method of spread has also been proved by the injection of solutions into the ejaculatory ducts and seeing them appear in the vas; also in Belfield's[9] experiments in seeing urine appear in vasotomy wound.

The tension increases and inflammatory reaction in the surrounding tissues becomes marked, a periepididymitis, the infection being carried *peritubular*, rather than *intratubular* to the rest of the epididymis. Cunningham[10] has never observed the testicle to be involved except by extension of the epididymal congestion over its surface. With increasing intensity of the infection, the tunical vaginalis, dartos and even the skin become involved through direct extension, causing the tail to become adherent to skin and filtration of the vas. Ingram[11] reports 3 cases of suppurating gonococcal epididymitis which ruptured, Kalopp[12] reports a case of atrophy of testicle following gonococcal epididymitis.

With the beginning of involvement the discharge may subside or even disappear at the meatus; there is an amelioration of symptoms, probably due to the fact that the ejaculatory ducts have become patent and the vesicles drain, and that the mobilization of the defense mechanism has shifted from the epididymis to the urethra. The epididymitis sometimes may be credited with having accomplished indirectly

what treatment has been trying to accomplish, cure a gonococcal infection. We certainly know that some cases present no further evidence of gonococcal infection. The reappearance of a discharge does not indicate that the epididymis is draining out through the vas and through the urethra, because in the majority of cases the epididymis has become occluded. Even after the periepididymitis becomes resolved, the body, etc., returning to normal, the tail remains hard and infiltrated as a stigmata of infection. If abscesses are present, they are generally found around the tail, and even if found around the body or head they are to the outside. Hydrocele to a marked degree may form, generally subsiding but in many cases persisting and increasing. We have seen one such case, bilateral, massive and requiring numerous paracentesis and later operation, a photograph of which is here shown (Fig. 1).

CLINICAL COURSE AND SYMPTOMATOLOGY

The symptomatology is typical and clear and well known: fever; often chills; faintness; a sickening pain in the testicle; marked tenderness, often most severe along the spermatic cord or referred to the lower back, often appearing before the stabbing, agonizing pain in the testicle, very sensitive to even the most gentle touch. Cord pain is due both to the drag of the swollen testicle as well as the swelling in the funicular sheath. It may be overshadowed by intense pain in the epididymis. The cord is often felt as a thickened cord. Pain is increased by motion. In many cases the symptoms are not so severe, merely a slight discomfort or pain on handling the testicle. There is in a large percentage of cases a cessation of the discharge from the urethra as mentioned previously.

Many patients take to bed of necessity, but a considerable number continue work. The active clinical course varies from one to three weeks. Prognosis is good, except for subsequent sterility. There generally remains a thickened, infiltrated and occluded organ. Epididymitis is the most frequent inflammatory cause of male sterility.

Wade[13,14] classifies the different clinical stages of gonorrheal epididymitis briefly about as follows:

Stage 1: Pain in the groin and along the course of the vas deferens and a feeling of discomfort.

Stage 2: The epididymis has become involved and there is swelling, tenderness and pain along the course of the vas, and general malaise.

Stage 3: There is considerable swelling of the epididymis with increase in the severity of the symptoms.

Stage 4: The epididymis is enormously enlarged, with a marked periepididymitis, involvement of the scrotum, and hydrocele makes its appearance. There is often high fever, toxicity and intense suffering.

Stage 5: This is the stage of resolution with gradual disappearance of exudate but often increased fibrous changes at the tail. The symptoms gradually cease.

DIAGNOSIS

The diagnosis is usually made by the patient and if not is readily made by palpating the acutely tender and swollen epididymis, often with a swelling and reddening of the scrotum, even becoming tense and shiny. If the case is seen early there may only be a funiculitis or involvement of globus minor and no periepididymitis. In the presence of hydrocele there may be some question; but the presence of an acutely tender hydrocele means an acute epididymitis is present. If there is a urethral discharge present and a smear shows the presence of an intracellular diplococci, the diagnosis is proved. There are cases that show neither a urethritis nor a history of antecedent urethritis; and there are other cases that occur without marked tenderness or systemic manifestation that often raise a question in our minds.

There is another group of cases that may puzzle us. This is the group that remain

in a subacute stage for some weeks, often raising the question of tuberculosis. Acute onset sometimes characterizes cases of tuberculous epididymitis and may be clinically indistinguishable. The mistake is usually made in diagnosing such cases as tuberculous. In tuberculous epididymitis there is a more gradual onset and generally the condition has existed for sometime before the patient seeks treatment. Kretschmer[15] found in 85 cases of tuberculous epididymitis that 70 cases showed changes in the prostate and vesicles. In 75 cases, 79.8 per cent showed either clinical or *x*-ray evidence of pulmonary tuberculosis. Stevens[16] points out that bilateral involvement favors tuberculosis and that scrotal sinuses of more than a month's duration are probably tuberculous.

The differential diagnosis between a gonococcal epididymitis and a non-gonococcal, non-tuberculous epididymitis may be difficult in the absence of an urethral discharge or if a discharge is present, absence of gonococci, or if the epididymitis precedes the urethritis. If a predominance of pyogenic organisms, other than the gonococcus, are found in the smear and there is a negative history of gonococcal infection, we may assume that the case is non-gonococcal, non-tuberculous.

Torsion of the cord may simulate an acute epididymitis, but it is rare and there is the absence of other clinical data. Luetic epididymitis is very rare; generally it is an orchitis, without an acute history. Rolnick[17] reports 3 cases secondary to or associated with orchitis. It more nearly resembles tuberculous epididymitis and the head is always affected.

TREATMENT

When we consider the modern conception of the etiology of gonococcal epididymitis, mechanical transfer of the gonococci-laden material from the posterior urethra to the epididymis, there is offered to us a definite program for prevention. In the presence of a known active gonococcal infection the patient must be warned not only against sexual intercourse, but against sexual excitement, "petting"; heavy lifting, particularly with a distended bladder. If there is an acute posterior gonococcal infection, no injections or irrigations should be used until the acute inflammatory reaction subsides and even when injections are started they should be gentle and irrigations should be given with low hydrostatic pressure only. Of course, no instrumentation should be done as long as gonococci are present. No massage of the prostate or stripping of the vesicles should be performed until all acute symptoms have subsided.

Yet, despite these precautions, epididymitis will occur. When it has developed, how shall we treat it? The main factors in the treatment are:

1. Alleviation of pain and swelling and relief of systemic manifestations.
2. Prevention, if possible, of occlusion of the ducts and thus the prevention of sterility.
3. The eradication of all gonococcal infection in the genital tract.

The treatment of epididymitis has been varied and often a source of disappointment to patient and physician alike. A host of therapeutic measures have been advocated, indorsed and discarded; testicular supports; vaccines, stock as well as autogenous; scrotal irritants, such as 50 per cent guaiacol in glycerine or ichthyol ointment, etc.; modified constriction hyperemia, produced by rubber bandage compression and diathermy more recently; non-specific proteins; turpentine injections and the intravenous injections of mercurochrome-220 soluble, sodium iodide and later calcium chloride.

Calcium chloride has been advocated by Leff and Spencer,[18] Rupel,[19] Cerf[20] and Wade,[3,4] on a basis of increasing phagocytosis and reducing inflammation in the tissues. We regret to say that we have not given this method a trial. It did not appear rational to us. Wade[3,4] states that in the early stages of epididymitis, putting the patient to bed, applying ice and bags

giving intravenous injections of 15 grains of calcium chloride daily, along with vas injections will often abort a case. Rupel[19] treated 28 patients with an average of 4.1 days in bed and 22 cases of the 28 were treated in the office. Cerf[20] concludes after its use, "it has a decided effect in causing rapid subsidence of swelling and in hastening absorption."

We gave sodium iodide intravenously rather an extensive clinical trial, but failed to be impressed with its use, despite the claims of my good friend Dr. Louis T. Wright[21] of Harlem Hospital, New York, Hutchinson[22] concludes that next to operative treatment, sodium iodide is most effective. Ravich,[23] Stern and Ritter[24] draw similar conclusions. There certainly is no real scientific indication for its use and we abandoned its use some years ago. The results were very variable with abject failure predominating.

In 1924, Wren and Tenenbaum,[25] in a series of 100 cases, used turpentine injections in 0.5 c.c. to 1 c.c. of 20 per cent emulsion of rectified oil of turpentine in sterile olive oil. The injections were given according to the original technique of Klingmueller.[26] The site of injection is the point of intersection of a line drawn from the posterior axillary border and a line figured two finger-breadths below the brim of the pelvis. At the intersection of these lines the needle is thrust in until it strikes the periosteum of the bone, upon which the injection is administered. We used this injection in 21 consecutive cases and the conclusions of Wren and Tenebaum were substantiated. The relief of pain and involution of the scrotal contents were striking, generally all pain and fever disappearing by the following day when the testicle could be compressed without causing pain within at least forty-eight hours. There was but little effect in our series in the disappearance of the urethritis. We were forced to abandon this method of treatment because of the increasing number of patients who, while having the pain in the scrotal relieved, complained of pain and numbness in the hip, radiating down into the leg. One patient limped for three days. Apparently my technique was faulty, but we could not seem to correct it. Of all methods of conservative treatment this one allowed massage of the prostate earliest, generally within two to three weeks after last injection, thus eradicating a potential source of reinfection.

We have recently been using, in combination with other routine methods a non-specific protein injection, in 10 c.c. intramuscular injections at two to three day intervals. The intramuscular use was advocated by Muller and Reese,[27] Blamoutier[28] used milk injections and feels it shortened the course and allowed urethral treatment earlier. As a rule pain disappeared within twenty-four hours, not quite as dramatically as with turpentine injections. Campbell[29] in a series of 50 cases could demonstrate no particular value. We found it had little or no effect on the urethritis.

Diathermy has been very favorably advocated by Corbus and O'Connor.[32] Some of my colleagues speak very highly of its analgesic effect and its effect on resolution, while others see no marked advantages. Campbell[29] could see no marked advantages over his adhesive suspensory. We have had no personal experience with diathermy.

Meridith Campbell[29,30,31] of Bellevue, who has made such an extensive study of epididymitis, having studied 3000 cases, believes that splinting of the scrotal contents causes the most rapid relief of pain, almost immediately. He puts the patient to bed, splints the scrotal contents according to an adhesive plaster method used at Bellevue and later to be described. He applies an ice bag. He found that in 50 cases treated without adhesive suspensory and with ice bag alone, pain remained

[1] Since the writing of this paper a personal communication from Dr. A. A. Wren, informs me that he and his associate had also abandoned "turpentine injections," some time past, for the same reasons as stated here.

longer. In 100 cases treated with the suspensory, the results were equally as good with or without ice bag.

Cases treated by me with vaccines seemed but little influenced.

It is not in the mild cases that treatment has been unsatisfactory but rather in the severer types, beginning with high fever, severe pain and marked systemic manifestations. This form has enlisted all the skill and ingenuity of the physician. Eric Stone[33] in a recent paper makes an analysis of 215 consecutive cases, comparing the results of various treatments. He makes in substance, the following conclusions:

1. Expectant treatment alone is insufficient.

2. Epididymotomy gives immediate relief of pain in a large number of cases; shorter time of incapacity, about one-half the time, compared with expectant treatment; and shorter time of involution except with non-specific protein injection. It lowers the percentage of recurrences, except that it is excelled by mercurochrome—220 soluble.

3. Sodium iodide intravenously gave poor results.

4. Non-specific protein injection stands next to epididymotomy in relief of pain and is more effective than any other agent in shortening the stay in the hospital.

5. Mercurochrome-220 soluble is next to non-specific protein injection in relief of pain.

6. Diathermy, if the cases are seen early may prevent any incapacity, but does not affect the pain.

The question when to use surgical treatment is often difficult to decide. Cunningham[10] believes epididymotomy offers the best means of treatment and he operates in most of his cases. Hagner[34] whose operative technique for epididymotomy is almost universal, believes that only the severe cases should be operated. Campbell[29] advocates epididymotomy in cases that have pain persisting after forty-eight hours, after rest in bed, scrotal splinting and ice cap and also in cases of painful chronic epididymitis and recurrent cases. Wade[3,4] believes that in cases of epididymitis with advance inflammation, cases in his group 4, epididymotomy should be performed in the first four or five days and thus sterility can be prevented. Allen[35] advocates early epididymotomy for the following reasons:

1. It shortens the time of disability.
2. It gives complete relief from pain.
3. There is immediate relief from toxemia.
4. There occurs a minimum destruction of healthy tissue.
5. There is a total absence of recurrences.
6. The procedure is simple and quick, usually taking about five minutes after the patient is anesthetized.

Pelouse[2] does not believe that the end-results of surgical treatment have been any better than the non-surgical methods, despite its widespread popularity. Cases developing definite abscesses of the epididymis demand surgical drainage, but there is no need for epididymotomy to become a general procedure. We are heartily in accord with this position. In my series of cases, there were 2 with marked tension of scrotal contents; we performed aseptic aspiration with a wide bore needle fitted upon a record syringe, with marked relief of pain and early resolution.

EPIDIDYMOTOMY

The operation of epididymotomy according to the Hagner[34] technique is the one generally used. He believes that it is only indicated in the graver cases. It is based upon the simple principle of drainage. The technique has been so well standardized and so often described that we shall do no more than show its technique in the film to follow this discussion. Belfield's procedure of vasotomy is often combined with epididymotomy. Cunningham's[10] cases did not show results different from those in which operation was not done. It must be remembered that curing the epididymitis is often simple compared to the eradi-

cation of the gonococcal infection in the prostate and seminal vesicles. They must receive appropriate treatment. Epididymotomy certainly allows early follow-up treatment.

Epididymectomy should be restricted to cases of remission after epididymotomy, in cases of long-standing, tender, bilateral epididymitis. We recently recommended epididymectomy in such a case in a man past fifty who has had recurrent bilateral epididymitis and a constant dull pain and tenderness in both epididymi for one year and frequent flareups with urethritis from which gonococci can be cultured.

The procedure that we have employed in our most recent cases is about as follows:

We believe that by far the greater number of cases can be treated ambulant. If the disease is very acute we generally put the patient to bed for at least two or three days. The patient is given a cathartic, abundant fluids, and the scrotal contents elevated by the adhesive suspensory advocated by Campbell[29] and perfected at Bellevue Hospital; and an ice cap is applied. If the ice is not tolerated, hot moist magnesium sulphate solution compresses are used. Non-specific protein injections, 10 c.c. intramuscular, are given in the gluteal muscles every day until pain, tenderness and fever have subsided; usually 4 or 5 injections are sufficient. Some sort of ambulatory scrotal support is used for at least the duration of the treatment. The ordinary jock-strap with the scrotal contents pushed forward by a nest of cotton is good.

As has been indicated, it is very necessary to eradicate all gonococcal infection. If there is a discharge we institute personally administered urethral injections of one of the silver salts at about the second week and at the third week we do not hesitate to give irrigations, with low hydrostatic pressure, at the height of about 2 ft. Massage of prostate and stripping of the vesicles are begun as soon as the urethritis has cleared up and the gonococci have disappeared. This treatment is continued as described in a previous communication[5] and the same standard of cure adhered to as advocated in a previously published paper.[36]

CONCLUSIONS

1. Gonococcal epididymitis is the most frequent disease of the testicle and the most prominent cause of male sterility.

2. Chemical irritation; instrumental trauma; and sexual excitement with an overdistended bladder in the presence of either an active or latent gonococcal infection, are the most common causes of epididymitis.

3. Epididymitis is the result of a mechanical transference of gonococci-laden pus from the posterior urethra and seminal vesicles down the vas to the epididymis. It is peritubular extension and not intratubular, involving principally the globus minor and the other portions of the epididymis by periepididymal extension. It is a true epididymitis and not an epididymo-orchitis.

4. Prevention may be achieved by rest, physical and sexual; gentle and skillfully applied urethral medication in the presence of gonococci, and gentle prostatic and vesicular massage and instrumentation in latent injections.

5. Our clinical experience leads us to believe that in the vast majority of cases conservative treatment, rest, scrotal splinting, intramuscular injections of non-specific protein injection will yield good results, many cases remaining ambulant. Operative treatment is indicated in the fulminating cases not yielding to conservative treatment and in recurrent cases and in cases not resolving.

6. Thorough eradication of all foci of infection in posterior urethra, prostate and vesicles is necessary, regardless of type of treatment employed.

[*For References see p.* 482.]

THE PRESENT STATUS OF UNCOMPLICATED GASTRIC AND DUODENAL ULCER*

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THE discussion will be limited to cases of non-specific uncomplicated ulcer of the stomach and duodenum; that is, no case of tuberculous, syphilitic or other extraordinary infection will be included; nor any case of ulcer, complicated by hemorrhage, perforation or anatomical stricture or distortion.

The whole cycle of experimentally produced peptic ulcer in animals has again been thoroughly reviewed in the last few years by Kirch and Stahnke, Wolfer, Caylor, Crohn, Weiskopf and Aschner, and Mann and his co-workers, from the first break of the mucosa with hemorrhage and destruction of the epithelium to the covering of the scar-filled defect. The important fact which has often been emphasized is the rapidity with which gastric defects heal. Clinically this laboratory fact should be associated with the rapid regression of ulcers in the intermission periods. This may possibly explain an occasional case of negative finding at exploratory laparotomy in cases with suggestive ulcer history and positive physical and laboratory data. For instance, in a series of such cases reported by Crohn, Weiskopf and Aschner, in which a second exploration was done at a later date during a recurrence of the symptoms, the patient showed definite ulcer.

In summary, it may be said that pathologically peptic ulcer is an inflammatory lesion so situated that gastric juice has possibly something to do with the destruction of excessive amount of tissue. That the inflammation is primary is strongly suggested. Various predisposing causes seem to be operative in the patients, but these are not conclusively established. The direct exciting cause of ulcer has, however, not yet been disclosed in such a fashion as to be beyond doubt. The persistence or chronicity of the ulcer depends on a variety of factors none of which can be said to operate in all cases. Probably several of these factors are coincidentally in evidence. Thus, there must be considered especially hyperacidity, stasis of neuromuscular or obstructive origin, the irritative and traumatic influence of gastric contents, and the traction of muscle about the ulcer.

Von Bergman's spasmogenic theory of ulcer as studied by Nakashima does not seem to me to have much etiological importance. Personally I have always felt that spasmogenic manifestations have been "accessories after the fact," results and not causes of ulcer. Experimental work on the subject has given very divergent results which do not by any means always support the neurogenic theory. In Schmid's studies none of the findings indicated did damage to the nerves with certainty. McCrea's evidence shows: (1) That the anatomical distribution of the nerves to the stomach is sufficient to account for instances of reflex spasm or of incontinence of the pylorus in the case of gastric or duodenal ulcer, and of spasm or of atony of the body of the stomach with duodenal ulcer; (2) that the "ulcer-bearing" area of the stomach corresponds to the area in which the nerve branches are chiefly grouped; (3) that local spasm with resultant anemia is a probable cause of the chronicity of ulcer, aided by factors such as retention and infection set up by reflex spasm; (4) that certain of the "gastric neuroses" may be exactly simulated by the resection of either the vagi or the nerves; (5) that the results of nerve stimulation and therefore of nerve irritation can also simulate certain of these "neuroses"; (6) that the phenomena grouped under the title of

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the "nervous dyspepsias" or "gastric neuroses" may have at least three sources of origin. These sources are: (a) peripheral irritation of the nerves, manifested by gastric signs and symptoms; (b) lesions of the nerve paths; (c) central disorders, possibly of endocrine origin. Such secondary phenomena probably account for those forms of acute pyloric obstruction which occur in the presence of an old pyloric stenosis as described by Delore, De Rougemont and Greyssel.

I shall not say very much about the question of gastric chemistry inasmuch as it will be found necessary to go into this more fully and to the point in a subsequent part of my discussion. Suffice to say here that ulcers while usually existing in a condition of increased gastric acidity are also nevertheless found in conditions of lessened or absent acidity and that in the postoperative periods an immediate fall of acidity should be held in question until the permanent effects of the operation are demonstrated. This is so because some work of mine which was published about ten years ago showed conclusively that immediate effects are often most temporary.

Recent studies are making us return to the old inflammatory theory of Cruveilhier. Duval and his co-workers are impressed with the importance of this factor and describe how infection modifies the clinical symptoms and the histological and biological findings of all forms of ulcer including even those of perforated ulcer. These studies are confirmed by those of Konjetzny. In all cases of ulcer Konjetzny, Orator and Kalima have found a gastritis localized chiefly in the pyloric antrum. This observation has been confirmed by Bohmansson's findings in freshly resected specimens. In the more chronic, plasma cells and regressive changes are predominant, whereas in more recent cases and in acute exacerbations in chronic cases additional leucocytes is great numbers and not infrequently suppurative processes in the mucous membrane and miliary abscesses are found. The constant presence of plasma cells even in acute ulceration of the mucous membrane with hemorrhage indicates that the gastritis is older than the ulceration. In all probability the inflammation in the pyloric part of the stomach is primary and constitutes one, and perhaps the most important, factor in the so-called gastric ulcer diathesis; in cases of chronic ulcer diathesis. In cases of chronic ulcer with acidity there is generally a condition of atrophic gastritis with increased connective tissue formation and glandular atrophy. In cases of acute ulcer the inflammation is not intense. The varying degrees of acidity may possibly have something to do with the different stages of gastritis.

Each year the subject of gastritis assumes a larger importance especially in its relations to gastroduodenal ulcer and to its consequential phenomena after stomach operations for ulcer. Certain clinical observations also indicate that the inflammatory phenomena are not always to be considered solely as secondary processes, and Duval believes that secondary infection of this kind is present in only about one-third of the cases of gastroduodenal ulcer. Microscopic examination of his specimens corroborates this assumption and the cultures yield streptococci or enterococci.

It should therefore be remembered, as a practical fact, that a chronic gastritis forms an important part of ulcer, and Korbsch has been able to see and treat this inflammatory condition through the gastroscope. According to Monsarrat, a specific organism is not essential for this association. As will be seen later this viewpoint has important bearings on the therapeutics of ulcer.

In deciding the question of medical or surgical treatment in any individual case there are many factors to be considered. In any case the economic status of the patient is a matter of great importance because medical treatment requires long-continued and tedious management and surgical treatment must be followed by a long period of medical care.

The social and biological characteristics of the class or group in which the individual patient belongs are also of extreme importance and will strongly influence the patient's reaction to the medical or surgical means employed to combat this most refractory of diseases. The capabilities, the knowledge and the technical abilities of the surgeon personally responsible for the management of the case are of paramount importance when the question of surgical therapy is considered and no one in justice to the individual patient should be selfish enough to exaggerate his own abilities when deciding upon the actual type of operative interference to be selected. All of these factors go hand in hand to the greatest extent with the particular environmental factors which characterize individual clinics.

Lahey among others, is convinced that gastric and duodenal ulcers are in no way primarily surgical diseases. They become surgical only when they have been demonstrated to be non-medical in the course of medical treatment. He believes it to be unjust to subject patients with ulcer to surgery without a careful trial of medical management and in this he but repeats what everybody else has said for the longest time. Because of the postoperative complications of gastroenterostomy, such as jejunal ulcer, the higher mortality of partial gastrectomy, and the uncertain future for the achylic stomach, the surgeon operating for peptic ulcer should be certain that a thorough preoperative medical regime has been tried. Lahey uses the Sippy plan of treatment, and hospitalizes the patient for three weeks if necessary. During this time the diagnosis is established, relief of symptoms is obtained, and the patient is taught the dietary routine he must follow for the coming year. The cat in the bag with this line of treatment, however, is that it is not always as easy as it seems. Such courses of treatment take a well-lined pocketbook and plenty of leisure time. For the working man or the one with moderate income it is frequently impossible.

The special indications for medical management of ulcer are:

1. Poor surgical risks in which the immediate danger to life is greater with surgery than with medical management.
2. Ulcers located on the upper border of the cardia near the esophagus where excision seems to be difficult.

The indications for operation in cases of ulcer of the duodenum depend upon several factors. (1) The length of time the symptoms have been noted should be considered; if the symptoms have been present a long time, and especially if the patient has had several periods of good dietary management without relief, operation should not be postponed. If the symptoms have been present for only a short time non-surgical treatment should be instituted at once as there is plenty of evidence to show that dietary management started before the condition becomes chronic may result in complete relief of symptoms and the healing of the ulcer. (2) The age of the patient should be taken into consideration; a young person with mild symptoms of short duration should be placed on a dietary regimen for a considerable period. In any case the severity of the symptoms will help to determine the plan to follow because if there is a constant tendency toward perforation, bleeding or severe gastric disturbances not quickly relieved by diet, operation is indicated. In all cases of duodenal ulcer diet should be tried before operation is considered. It is a mistake, however, to continue dietary treatment if nothing is being accomplished by it and if the symptoms return following the least indiscretion. Many duodenal ulcers, even though chronic, run a mild uncomplicated course so that the patient may be treated medically with the idea of eventually resorting to operation if the result of the non-surgical treatment or the cooperation of the patient is unsatisfactory. Duodenal ulcer is a common lesion. Between 1200

and 1500 patients thus afflicted are seen in the Mayo Clinic every year, but only about 65 per cent of the patients with duodenal ulcer who enter the Mayo Clinic undergo operation.

Although there seems to be almost universal agreement about the advisability of subjecting patients to medical treatment at first, especially those with duodenal ulcer, the astounding thing about this attitude is that one detects very easily underlying the discussion the lack of confidence which everyone has in the possibility for permanent cure of medical courses of treatment. I myself am inclined more and more to believe that the medical cures of gastric and duodenal ulcer are really not cures but remissions of symptoms or temporary closures of ulcerated areas, which at the slightest provocation owing to the underlying "ulcer" susceptibility, will reopen again in the same or in new locations.

I say this advisedly in spite of the fact that I have repeatedly seen on the operating table the scars of healed lesions in the stomach wall which almost invariably are ordinarily taken to be healed ulcers. I believe that many of these healed lesions are merely in a temporary state of healing; or that they are the results of embolic lesions in which the underlying "chronic ulcer" cause is not present. I have spoken of this conception on several different occasions. Given a lesion of this kind it would be idle and ridiculous to attempt surgery when it is the rule to expect permanent healing after almost any kind of conservative treatment. This is probably the source of all medical cures.

There seems to be entire agreement among medical and surgical men that when medical forms of treatment fail and are inefficient, then one should unhesitatingly resort to surgery. But here the trouble begins and there is an entire lack of harmony among different men both in the same and in different localities as to the effectiveness of any form of surgical procedure for uncomplicated ulcer, (except in the one form of non-ulcerated pyloric stenosis by scar contraction, for which gastroenterostomy is the standard treatment).

The conviction has been spreading that progress in the management of peptic ulcer will depend on a more intelligent selection of cases for operation and a better appreciation of the general principles of those operations which experience has shown to be worthy of application. The selection of the operation depends upon many factors, the chief of which are the condition of the patient, the stage of the disease, the situation and character of the lesion, and the complication associated with it. (In Judd's opinion, the present enthusiasm for resecting the stomach for duodenal ulcer will not last very long.)

It would be idle to go through the great number of published reports which have appeared during the last year or two with their masses of statistical information and personal impressions inasmuch as it does not add to one's information; any individual year's crop of literature usually repeats more or less that of former years. The impression which is conveyed is that the entire discussion boils itself down to the choice between the various forms of gastrojejunostomy and of pyloroplasty and some form of extensive resection of the stomach.

This choice seems, however, still to be one of the most difficult there can be. In many American (Deaver, Pool, Peck, Woolsey, etc.) and English (Sherrin, Walton, etc.) quarters, gastrojejunostomy is still the operation of choice, but there is a tendency in other quarters (Pamperi and Schwartz from Schloeffer's Clinic in Praque, Starlinger from Ranzi's Clinic in Vienna and Innsbruck) to appreciate the fact that as time goes on the gastrojejunostomy cases tend to grow worse, whereas the resection cases show the tendency to get better and better.

In the immediately preceding years there has been brought out the important fact that the trouble with gastrojejunostomy is that in many of the patients, and the proportionate number varies widely, a

recurrence of symptoms takes place which is almost invariably due to the presence of a secondary ulceration in the neighborhood of the stoma. Everyone agrees that the secondary ulcers occur; but the difference in weight which is given to this accident varies widely in different clinics owing to the apparent differences in the percentage number of cases. The variation extends from relative indifference to an attitude in which gastroenterostomy is recognized as a disease per se. Those who report small numbers of such secondary ulcers put the onus of the larger percentage reported by the others on various factors which to my mind appear trivial except for the one factor which concerns itself with the different type of human material upon whom the operation of gastrojejunostomy is carried out.

In America, this factor has only lately made itself apparent. It has been emphasized by the large number of secondary peptic ulcers which have been reported as occurring in Jewish patients (Lewisohn's report from the Mount Sinai Hospital service of Berg). In the Mayo Clinic (C. H. Mayo) it is believed that this large percentage has intimate relations with the racial characteristics of the Jewish people. But in widely different parts of the world, Bastianelli (Italy); Haberer, Finisterer, Koenig, etc., (Germany); Hartman, Duval, etc., (France); Ranzi, von Eiselberg (Austria); Arn, Deaver, etc., (America); Starlinger (Innsbruck); Grekov (Leningrad); Urrutia (Spain); Moynihan (England); Lengemann, Schwartz, etc., reports are forthcoming from sources in which this factor does not enter; and in these, nevertheless, the numbers of secondary ulcers have been large enough to cause the abandonment of gastrojejunostomy. At the meeting at which Berg reported his results of gastric resection in which the subject of secondary ulcer was discussed, one of the men (Russell) intimated that possibly the small number of recurrences which their men reported were due to inefficiency of the given follow-up system which was employed.

Nevertheless the men (Sherrin, Pool, Flint, Deaver, W. J. and C. H. Mayo, Balfour, Peck, Galpern, Schuyzer etc.) who prefer gastrojejunostomy, hold tightly to their preference; as a matter of fact, just as tightly as do those (Haberer, Finisterer, Berg, Lewisohn, Duval, Eiselberg, Grekov, etc.) who would abandon the operation for the larger resection. I think possibly just at present the balance of the scale is a little in favor of the resection operation. And I really believe, that were it not for the larger mortality of resection operations in less experienced hands, and the lack of confidence of many surgeons in their ability to make a good showing with gastric resection, that the larger type of operation would, for the present at least, advance in favor with leaps and bounds. This is possibly the cause for the recent tendency to conservatism on the part of some, notably, Bier, Kuttner, and Payr.

It seems to be almost an unwritten rule in medicine and surgery that no one procedure is applicable to all cases of any given entity; and, in many quarters, (Gilbride, Lahey, Horsely, Finney, C. H. Mayo, Woolsey, Pamperi and Schwartz), the rule is made to apply to ulcer cases. However, at Finisterer's Clinic, and at the Mount Sinai Clinic (Berg), resection is done as a routine measure on all patients who apply for relief of ulcer without regard to any of the factors upon which and because of which in other clinics a selection is made from the available procedures; other things being equal, I should myself lean to the resection form of operation.

The rationale of the resection operation as practiced for gastric ulcer is not the same, however, in the various clinics. In the German clinics (Finisterer, Haberer, etc.) the purpose of the resection is to remove so much of the stomach wall as to reduce the acidity of the stomach contents to as near zero as possible; the American school (Berg, Lewisohn etc.) follow the German line of reasoning. In

the French School (Duval, Hartmann, etc.) the purpose of the resection is to move the focus of infection in the stomach wall (gastritis, etc.) as completely and as radically as if one were operating for malignancy, inasmuch as it is believed that infection and not acidity is the dominating factor in producing secondary ulcer. In the American School (Lewisohn) it is, however, recognized apparently that infection (gastritis) plays some part in the total pathologico-clinical picture, because the purpose of doing resection of the body of the stomach in duodenal and other forms of non-resectable ulcer after the manner and method proposed by Finisterer, is said to be not only for the purpose of decreasing the acid-producing part of the stomach but to remove an abnormal wall which is the only seat of a gastritis of greater or lesser extent.

Recognition of the importance of gastritis also as a potential source of disaster in the surgical management of ulcer is stressed also by Gregoire and Bohmansson. There are periods in the course of a gastric ulcer during which there is a distinct exacerbation of the infective process. These are characterized by an elevation of temperature, which may reach 39°C. or more, a corresponding elevation in the pulse rate, an increase in the intensity and duration of the pain, and the occurrence of gastric hemorrhages. Operative interference during such periods is attended by the gravest danger because of the tendency of the manipulations to disseminate the infection. Surgical measures should therefore be delayed until the crisis has entirely subsided.

It is for this reason that Duval's contention seems correct that limited resection of the stomach has a higher mortality than extensive resection or gastropylorectomy because the former may be performed in infected tissue whereas the latter are done outside the limited zone of infection. Nicolaysen goes even further and believes that operation for gastric ulcer should not be performed in the period of infection. When infection is suggested, specific vaccination should be done until the biological tests become normal. If an emergency operation is necessitated by complications, it should be extensive enough to be performed outside the infected zone. On the basis of histological studies these viewpoints are confirmed by Kalima and wider excisions are recommended.

The actual method of doing the gastric resection seems of no great importance. A number of methods (Polya, Hoffmeister, Schumaker, etc.) have been described as so-called new methods and several (Hoffmeister, Polya) of them have come into prevalent use. Nevertheless, the time-tried Billroth types of operation both 1 and 2 seem to hold their own very well, and, of these two, the type 2 is the easiest to perform while the type 1 is the best if the technical conditions in the operative field form no insuperable obstacle.

I get the impression that except for very few clinics the exclusion form of stomach resection for duodenal and other non-resectable forms of ulcer has not gained many adherents. The report of Schomberg from Florcken's Clinic is not very impressive. Judd is of the opinion that the present enthusiasm will not last.

Reports of the bad results which have followed the various forms of minor operation, gastroenterostomy especially, have been increasing in number. To quote a few of these: Finisterer, of Vienna, during a visit to this country in the fall of 1923 quoted the following statistics: Payr had in his material 62 per cent recoveries and 38 per cent failures; Bier 66 per cent and Haberer 37 per cent recoveries. Many reports from the French clinics also show unsatisfactory results. The series of statistics giving the worst results after gastroenterostomy published by an American surgeon, are those reported by Lewisohn from Berg's service at Mount Sinai Hospital. He reports that 34 per cent of the patients have gastrojejunal ulcers. This latter group of statistics is the basis for

the advocacy of the more radical subtotal gastrectomy.

The mortality of the exponents of resection as a substitute for gastroenterostomy is usually represented by those of Moynihan, Haberer, Finisterer, and perhaps others who have achieved a mortality of 2 to 3 per cent. It is proper, however, to emphasize the fact that such a mortality only prevails in the hands of expert operators, and under the most favorable conditions. In the hands of those not especially trained the mortality is doubtless a high one. It is, indeed, very interesting that most of the support in favor of resection comes from the internist. Many physicians who have had occasion to compare the permanent cures following resection of the stomach with the many failures following simple gastroenterostomy are strong supporters of the resection. The cooperation of internist and surgeon in the preoperative preparation of the resection patients has strikingly contributed to reduce the surgical mortality.

Preoperative factors enhancing the surgical end-results are the proper selection of the cases both from a general and a special standpoint, and from the complete examination of the patient. Increasing knowledge concerning physiological gastric types and their variations and mode of response to treatment, furnishes criteria for the proper selection of the individual operation. The patient who has been well chosen and skilfully operated on very often does well even without any exact postoperative regimen.

Secondary and Gastrojejunal Ulcer. The biggest problem today in gastroduodenal ulcer is that of the secondary (recurrent gastrojejunal or jejunal) ulcer. Recurrence of ulceration may follow any operation for peptic ulcer. The incidence of jejunal ulcer in many large series of cases, like those of the Mayo Clinic, Moynihan, Sherren, Walton, etc., is 2 per cent or under. Koennecke and Jungemann report 4 per cent in the Goettingen Clinic. In the German literature estimates are as high as 3 per cent. In Woolsey's series there were less than 2 per cent. In contrast to these, Lewisohn among 68 patients traced four to nine years after gastroenterostomy for duodenal ulcer, found 18 per cent of jejunal ulcers corroborated by operation, and 16 per cent more, diagnosed clinically and by roentgen-ray, a total of 34 per cent. A. A. Strauss reports 20 to 30 per cent of jejunal ulcers after gastroenterostomy and says that Karl Meyer found 25 per cent at the Cook County Hospital. These figures suggest some special factors to account for them in addition to the causes of jejunal just mentioned.

It has been stated in the American and English literature that gastrojejunal or jejunal ulcer followed gastroenterostomy in 1 to 3 per cent of cases. In the German literature this was estimated to occur in from 5 to 10 per cent of cases and several years ago Lewisohn reported the astounding number of 34 per cent. This number of gastrojejunal ulcers and the reported poor results from the foreign clinics caused the advocacy of more radical treatment of duodenal ulcer. Haberer was one of the first to use extensively the method of pyloric resection for duodenal ulcer, performing the anastomosis, a gastroduodenostomy, by a modification of the Billroth 1 method. This procedure was adopted by many European surgeons. Finisterer advocated and practiced a resection of from two-thirds to three-fourths of the stomach. Radical operations were becoming the fashion of the day.

Major resection operations are also proving no exception to the rule and as the result of the wide enthusiasm for resection, operations are coming to be counted secondary and gastrojejunal ulcers are being reported with apparently increasing frequency. Cole and Hoguet have reported a large marginal ulcer after Polya operation, (Lewisohn 3 cases following Billroth 2 operations). Finisterer reported 29 cases after the Haberer operation; Friedmann 21 cases; and at the Russian Surgical Congress Sokolov reported that

4.3 per cent of the gastrectomy cases were followed by gastrojejunal ulcer. Some of the latter occurred as late as seven, nine, twelve and twenty-five years. In Borger's case, resected by Kocher's modification of the Billroth 1 operation, the ulcer recurred at the junction of stomach and duodenum six months after the operation. Of particular interest is Sokolov's series of 126 cases of peptic ulcer of the jejunum in which the complication occurred after 4.3 per cent of cases in which gastrectomy was performed, and in 11 cases in spite of the fact that no clamps were used in performing the suture.

Bruett examined the ulcer material of the Eppendorf Clinic to see whether it was true, as was formerly believed, that jejunal ulcer occurs just as frequently after the Billroth 2 operation as after gastroenterostomy. Among 500 ulcer operations performed in the last six years there were 400 resections by the Billroth 2 method (Reichel-Polya) and 12 by the Billroth 1 method. In the same period, 15 patients having jejunal ulcer were operated upon, nearly all of them according to the Billroth 2 method. In 14 cases a gastroenterostomy had been performed previously. A Billroth 2 operation had been done previously in only 1 case and in this instance was performed for a jejunal ulcer which developed after gastroenterostomy.

In the 12 cases in which the Billroth 1 operation was done there were 2 recurrences, one at the suture line and the other in the duodenum away from the suture line. Therefore the good results obtained at other clinics with the Billroth 1 operation were not confirmed. This was evidenced also by 2 recent recurrences of ulcer in cases in which a Billroth 1 operation was performed at another clinic.

The 53 cases of recurring ulcer following partial gastrectomy reviewed by Balfour are divided into three groups: (1) 28 cases in which the ulcer was found at operation; (2) 20 cases in which a clinical or roentgenological diagnosis (or both) of recurring ulcer was made, but in which, chiefly because of mild symptoms, the patients did not come to operation, and (3) 5 cases in which the subsequent course was either positive or very suggestive of recurring ulceration. The second and third groups are not considered in this report. Of the 28 cases in which operation was performed, 14 followed resection for gastric ulcer, 8 were for persisting or reactivated duodenal ulcer following other operations, and 6 were for gastrojejunal ulceration. If these cases are classified according to operation, 3 followed resection of the Billroth 1 type, 6 followed resection of the Billroth 2 type, 10 followed sleeve resection, 7 followed a Polya operation of the posterior end-to-side type, and 2 followed resection completed as an anterior end-to-side gastrojejunostomy.

The Russian experience as given by Sokolov is particularly valuable inasmuch as the human material studied is essentially the same as that reported from other quarters where figures as high as 34 per cent were reported (Mount Sinai Clinic). Sokolov's experience gives the percentage of recurrence as from 1 to 2 per cent. Russian experience would indicate that it is impossible to perform a gastroenterostomy in such a way as to prevent the later development of this lesion. This is true also in the Russian cases of all methods of resecting the stomach with the exception of the Billroth 1 procedure. The nature of the suture and of the suture material, the use of clamps, etc., has no decisive influence upon the development of the peptic ulcer of the jejunum or gastrojejunal ulcer. In one-half of the Russian cases the symptoms of a peptic jejunal ulcer developed within a period of from one to two or three years after the primary gastroenterostomy, but in some instances there were painless periods of eleven, twelve and twenty-five years.

German (Bruett), English (Rowlands), American (Balfour), and Swedish (Nystrom) experience seems to show conclusively that a peptic jejunal ulcer may occur even after extensive resection of the

stomach. Nystrom does not believe that these ulcers are "achylic," but he believes that the gastric chemistry still favors their formation. Up to the present time Nystrom has been able to collect from the literature 62 cases of peptic ulcer following resection of the stomach.

Wanke reported from the Kiel Clinic 70 cases treated by a Billroth 2 resection without a recurrence of the development of a jejunal ulcer. In more than 300 cases in which a Billroth 1 resection was performed from two to fifteen years ago there were two recurrences, and ulcer tumor in the anastomosis and a callous ulcer in the duodenum. In both of the cases with recurrence it is reported that the resection had not been extensive enough and the acidity was high. However, the recurrent ulcer and the jejunal ulcer were not the only evidences of failure in the ulcer treatment and not all of the lesions in the other cases were healed.

The subject of recurrent ulcer and gastrojejunal or jejunal ulcer can well be discussed together inasmuch as the basic causes operating in each are essentially the same. One exception should, however, be noted in recurrent ulcers in that this sometimes is an error and hides the missing of a previously existing lesion. This, however, does not prejudice the main issue. The preceding years have noted two main groups of observations: (1) A line of thought in which technique is said to be at fault. A change is however being noted in that no longer are minor factors in technique being implicated; the discussion concerns itself now with broad principles of operative technique and with major types of operations. (2) A line of thought in which other factors than those associated with operative technique are said to be at fault; this includes such two important subjects as the retention in the stomach of excessive amounts of acid and the retention in the stomach of foci of infection. Necessarily both of these topics are more or less intimately bound up with each other. The major part of our discussion will take up the intragastric condition inasmuch as the types of operation necessary to correct these defects will first, be easily deducible therefrom and, second, the types of operation will be found to approximate themselves to one general group.

In recent years the presence of high acid contents in the stomach after operation has been associated in many men's minds with the appearance of secondary gastrojejunal ulcer.

Although ulcers may exist in the presence of a low gastric acidity, or absent in a high gastric acidity, it is assumed and proposed by an increasing number that the gastric acidity is the key to the "recurrence" problem; a properly reduced acidity means a cured patient. It is upon the question of acidity that the controversy mainly or entirely hinges. Those who, because of this belief favor the more radical procedure of resection have been charged with doing too great and an unjustified amount of surgery for the size of the lesion involved. This charge is possibly not a fair one since the gastric resection is not based upon the size of the lesion but upon the underlying chemical condition that is supposed to be responsible for the lesion.

This is the reason assumed at the Mount Sinai Clinic from which the exceptionally bad results reported by Lewisohn have come. And they carry this to the extent of believing, and the belief is based upon postoperative estimations of the gastric acidity, that when recurrences or gastrojejunal ulcers occur after resection the primary resection was insufficient in extent and they advise and do a further resection of the stump of the stomach.

The experimental work of Portis and Pertis shows that the gastric secretion in dogs after a subtotal gastrectomy shows an absence of free acid but a high combined acidity whereas the secretion from a Pawlow pouch, representing a similar part of the stomach, continues to secrete free acid after resection. They believe that the factor of neutralization plays the most important rôle in explaining the absence

of free acid observed experimentally and clinically in the gastric secretion after subtotal gastrectomy.

The artificial achylia produced may establish an entirely new and possibly harmful bacteria flora of the gastrointestinal tract, with consequent gastrointestinal abnormality.

At the Mayo Clinic (Balfour) the acid values of the gastric contents in cases of gastrojejunal ulcer as compared to the acid values before gastroenterostomy are usually, but not always of significance. In 40 per cent of their series of cases of gastrojejunal ulcer the free hydrochloric acid was either increased or very slightly reduced by the gastroenterostomy; but in 40 per cent, there was a marked reduction, and in 20 per cent, the free hydrochloric acid was reduced to zero. The fact that there was no free hydrochloric acid in one-fifth of the cases of gastrojejunal ulcer in which repeated and fractional examination of the gastric contents were made, possibly disproves the assumption of Lewisohn that achlorhydria following the primary operation affords protection against later ulceration.

Besides carrying the belief that this wiping out of the acid-making properties of the stomach is harmful, there are at least two reports (Ascoli-Konjetzny) which carry out this point of view. The past few years have seen a number of reports in which the association of the retention of relatively high values for the gastric acidity with the recurrence of ulcer or the appearance of gastrojejunal or jejunal ulcer is denied rather emphatically. This latter group associates the appearance of the secondary and gastrojejunal ulcers with the retention of foci of infection in the stomach wall.

The rôle of infection of the gastric wall and perigastric lymphatics in the development of recurrent gastrojejunal or jejunal ulcer is sponsored especially by Duval, Roux, Gautellier and Moutier and by Lecene. Duval, Roux, Gatellier and Moutier advanced this theory about three years ago. Today this theory is generally accepted in France and is becoming more widely accepted in Germany. These men believe that gastrojejunal ulcers result from a localized inflammatory process due to extension of the infectious process from the ulcer site in the stomach. They suggest that the absence of renewed ulceration after extensive resection is due to the removal of the entire infected area rather than to the elimination of the acid-secreting portion of the stomach. They believe that the secondary ulcers are caused by including a part of the inflamed gastric wall in the general area of the new anastomosis and that the infection is not confined to the new opening but spreads along the efferent jejunal wall. They do not believe that unabsorbable suture material has much to do with the development of ulcer unless it is used in septic tissue, under which circumstances it may become a factor. The stomach clamp and the use of hemostats and other forceps applied to an inflamed tissue may cause ulcer as the result of induced ischemia and the intraparietal effusion of blood.

The evidence of this condition need not necessarily appear immediately even though it does sometimes in many of the cases; but it may appear somewhat later after an initial period of apparent health. The tendency in these quarters seems to be to connect the postoperative condition with foci of infection which the incomplete primary operation failed to remove. In the hands of Hertel, gastroscopy has revealed the presence of serious chronic catarrhal changes of the mucous membrane after gastroenterostomy and in the retained fundus after the radical removal of the antrum and pylorus.

The study of the specimens obtained in Nordmann's secondary operations showed that the pathological findings were slight when contrasted with the symptoms, and he assumes that symptoms were due to a gastritis, to distortion of the stomach and to spasm. Corroboration of this can be found in the single significant observation

made by Winkelbauer and Hogenauer; in all the dogs subjected to a gastrojejunal anastomosis for the purpose of studying the development of postoperative peptic ulcers there was marked hyperemia of the mucosa and submucosa of the distal loop of bowel. This was present as early as the first day after operation and as late as the fourteenth day. They regard this fact as indicating that ulcers never develop in the normal mucosa.

Konjetzny corroborates the beliefs of Duval, Nicolaysen and Hertel even though he believes that the findings of gastroscopy are not as conclusive as those of histological examination. He has never seen a typical ulcer without gastritis.

Clairmont and many of the continental surgeons are unwilling as yet to make definite conclusions with regard to gastritis following operations on the stomach because they still lack data based on a sufficient number of systematic investigations and histological studies. The problem seems complicated by the fact that in all surgical operations which cause deformities the changes produced are so extensive that their effect upon the stomach is not to be disregarded. Clinical observations alone are not sufficient as frequently different conditions produce the same external signs. The most contradictory views were expressed by Schindler who has come to the conclusion from gastroscopic findings, that gastritis is not a prerequisite for the development of ulcer. Schindler stated that he had never observed diffuse gastritis in cases of round ulcer, but had frequently noted it after gastroenterostomy.

I confess that the bulk of the reported evidences, my own experience and the observations that I have been able to make in the hospital, seem to bear this viewpoint out strongly. Duval draws the practical lesson from these observations and belief that no operation should be attempted during an acute phase of infection or before the abnormal biological reactions have disappeared. To prepare the patient for the operation is the most important thing. Bedrest, preoperative vaccination, and operating in sound tissues improve the prognosis and prevent the subsequent appearances of secondary ulcerations.

According to Nordmann, the indications for a new operation in cases of patients previously operated upon for gastric ulcer depend upon the severity of the symptoms. As a rule, the most important symptom is intolerable pain, which is usually located in the mesogastrium, but often radiates to the back and occasionally also to the shoulder. Peptic ulcer of the jejunum can usually be suspected with considerable certainty. Roentgen-ray examination often leaves the diagnostician in doubt.

Secondary corrective operations are frequently postponed too long because of difficulty in determining the proper time for surgical interference. This difficulty is due to the fact that persons suffering from ulcer are usually of a nervous temperament.

Extensive resection is the best prophylactic treatment against recurrence of ulcer or the development of postoperative peptic ulcer. All of those in favor of the hyperacidity theory espouse this method of prophylactic treatment. However, in the opinion of those who believe in the "gastritis" theory, as defined by Duval, Nicolaysen and others the prophylactic action of extensive resections is due, not to suppression of the gastric zone which secretes hydrochloric acid, but to removal of the inflamed periulcerous zone. Nicolaysen believes that all operations for gastric ulcer should be preceded and followed by specific vaccination with streptococci or enterococci.

Rowland's discusses the following operative procedures:

1. *Simple Excision of the Ulcer.* If the ulcer is small and not encircling the stoma it is often possible to exercise it and sew up the resulting wound in such a way as to enlarge the stoma or jejunal channel. In some cases, however, the ulceration may recur unless all of the causes of recurrences are eliminated.

2. *Excision of the Ulcer and Abolition of the Stoma.* If the ulcer is large or encircles the stoma, which is often contracted, it is necessary to excise the ulcerated area, thus detaching the jejunum from the stomach and, occasionally, to make a new and better stoma. If the pylorus and duodenum are healthy and patent it is not necessary to remake the gastrojejunostomy and it is much better to close the openings in the stomach and jejunum, thus reestablishing the normal anatomy and physiology of the parts.

3. *Abolition of the Stoma plus Gastroduodenostomy.* If the original gastrojejunostomy was anterior it is possible to perform a gastroduodenostomy, using the opening on the anterior wall after excision of the ulcer.

4. *Partial Gastrectomy.* When the gastrojejunal ulcer is recurrent and complicated and when the duodenum is ulcerated, stenosed, or embedded in dense adhesions, it is wise to perform partial gastrectomy.

Allen's treatment of choice in marginal ulcer, when the primary operation was gastroenterostomy, is disconnection of the gastroenterostomy, resection of the ulcer and repair of the jejunum and stomach, provided that there is no stenosis in the pylorus, thus allowing the stomach to empty in its normal way. Allen does not think it justifiable as a primary procedure to sacrifice from one-half to two-thirds of the stomach for a duodenal ulcer when one cannot give the individual any assurance that the ulcer will not recur. Marginal or jejunal ulcers occur just as frequently after partial gastrectomy, and when they do recur a more formidable surgical procedure is presented than when a simple gastroenterostomy has been performed. An individual with a gastroenterostomy in whom a marginal ulcer develops has a much less hazardous condition than one in whom the primary operation was partial gastrectomy.

Cases of marginal ulcer in which the original lesion has healed call for restoration of the gastrointestinal tract to normal and excision of the marginal ulcer. If the primary ulcer is still active, the treatment indicated is resection of half of the stomach and the ulcer-bearing area of the duodenum or resection of the jejunum, if the ulcer is located in that portion of the small intestine, followed by end-to-end jejunostomy.

Horsley states that the selection of the proper operation for peptic ulcer depends upon a careful study of the case and of the condition found when the abdomen is opened. Both Horsley and Woolsey believe that the best treatment is partial gastrectomy with removal of a considerable portion of the acid-secreting part of the stomach. There seems to be no reason for merely excising the ulcer and reestablishing the gastroenterostomy.

At the Mayo Clinic (Balfour) it is always assumed that a well placed anastomosis has brought about the healing of a duodenal ulcer. If such healing has taken place without producing any obstruction at the pylorus, and if examination of the duodenum and pyloric end of the stomach seems to show that it will maintain adequate drainage of the stomach, Balfour believes that the simplest and most rational procedures for the cure of the secondary ulceration is the disconnection of the anastomosis and the excision of the gastrojejunal ulcer. If such an operation be performed it is the procedure of choice; at the Mayo Clinic it has the great merit of being conservative. It is more often true, however, that although the original ulcer has healed, it has healed with such extensive scarring or so much deformity has resulted from previous operations on the pylorus, that the latter is incapable of carrying on its normal function and an operation as simple as the disconnection of the anastomosis is unwise and not possible. When this simple operation cannot be performed, the operation of election, from the standpoint of immediate and late results is the disconnection of the anastomosis with excision of the ulcer and partial gastrectomy.

Up to April, 1926, partial gastrectomy had been performed at the Mayo Clinic for uncomplicated gastrojejunal ulcer in 89 cases, with death in 3, a mortality rate of 3.37 per cent. This mortality rate is not excessive in view of the frequently formidable nature of the operation, the condition of the patient, and the excellent results which follow the operation. The most common and, unfortunately the most serious complication of gastrojejunal ulcer is the formation of a gastrojejunocolic fistula. Such a complication adds to the difficulty and risk of the operation. It is actually an unnecessary complication since there is always evidence of the ulcer long enough before the development of the fistula for the institution of adequate surgical treatment.

At the Mount Sinai Clinic (Berg) adherence to the principle of subtotal resection is held and all cases of secondary ulcer after previously performed primary operation of whatsoever kind are treated routinely in that fashion. The mortality is about 22 per cent. Their experiences with the palliative forms of operation have not yielded such good results as are obtained in other clinics so that the minor forms of operation have been gradually and totally abandoned. This is a much more radical attitude than is ordinarily held; it is held on the same grounds as have impelled the men at Mount Sinai to practice routine subtotal resection of the stomach in the primary operation for gastric or duodenal ulcer; and, whatever one may say as regards the practices, beliefs and results obtained at other clinics, the radicalism seems to be necessary at that clinic because of the kind of patients and the character of the results which are obtained there.

The symptomatic results following partial gastrectomy for gastrojejunal ulcer fully justify adherence to the principle that this operation is necessary, certainly in cases which do not permit the conservative practice of disconnecting the anastomosis only and possibly as a routine measure. Complete relief of symptoms follows the operation in more than 85 per cent of the patients who recover from the operation.

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THE DIAGNOSIS AND TREATMENT OF ACUTE CRANIOCEREBRAL INJURIES

A COLLECTIVE REVIEW*

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PART II*

TREATMENT OF ACUTE CRANIOCEREBRAL INJURIES

Immediate Treatment

Within the past decade the general trend has been toward conservatism in the treatment of acute craniocerebral injuries. Prior to this time, because of the relatively greater importance given to localized intracranial hemorrhage, operative procedures for the relief of intracranial tension were practiced rather frequently. At the present time it is realized that in by far the greater majority of cases increased intracranial tension is the result of edema which is dependent upon the cerebral trauma. The difference in treatment as practiced today from that practiced a decade ago is illustrated by the following figures: Sharp[60] (1916) operated upon about 30 per cent of his craniocerebral injuries; Wilensky[71] (1919), 24 per cent; Heuer[72] (1929), 23.7 per cent; Naffziger[36] (1923), 20 per cent; whereas Crawford and McClure[3] (1928) in their series of 441 cases operated upon only 4.3 per cent of the cases, and Fay[11] (1930) operated upon only 4.1 per cent of his cases. It is now generally accepted that in the majority of cases of craniocerebral injury, at least in those with no localizing signs, conservative treatment is not only less dangerous, but is more efficacious than operative treatment.

As many patients with acute craniocerebral injuries when first seen by the surgeon are in surgical shock, it is imperative that the shock be treated before the institution of any other therapy. The patient should be immediately put in bed, external heat applied, and hot fluids administered. Fay[11] warns against the use of adrenalin or caffeine in the treatment of these cases, except in desperate cases as they frequently cause temporary improvement in the patient's condition and apparently later depress the circulatory and respiratory systems. He does employ pituitrin or strychnine, however. The administration of hypertonic glucose solution intravenously is justifiable, because not only is it of value in combating shock, but it is also of value in preventing and combating cerebral edema. Thomas[73] and Fay[11] recommend the administration of 50 per cent glucose solution in all cases of cerebral injury, even though cerebral edema is only suspected. They employ 50 to 100 c.c. of 50 per cent solution and believe that it is of distinct value in the treatment of shock. Fay[11] follows the administration of the hypertonic glucose solution with normal saline solution. Any external wound should be cared for as soon as possible, although undue manipulation is to be avoided until the patient recovers from shock. As soon as the patient's condition permits, an examination, especially a neurological examination, should be made, especial care being paid to the cranial nerves, pupillary reflexes, evidences of discharge of blood or spinal fluid from the ears, nose, or mouth, and evidences of paralysis or weakness. Even though these findings may not be abnormal, a record is extremely important in order to determine whether any deviation from normal subsequently occurs. Lumbar puncture should be performed as soon as the patient recovers from shock, both as a diagnostic

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and therapeutic procedure. A cerebrospinal fluid pressure higher than 10 mm. of mercury should be considered abnormal and enough fluid should be removed cautiously to decrease the pressure above 10 mm. of mercury by one-half; i.e., if the cerebrospinal fluid pressure is 20 mm. of mercury, enough fluid should be withdrawn to reduce the pressure to 15 mm. of mercury. Roentgenograms of the skull should be made as soon as the patient recovers from shock in order to determine the presence of a depressed fracture. As recommended by Weaver[40] and Davis,[49] in those cases in which there is discharge of blood or cerebrospinal fluid from the ears, no attempt should be made to irrigate the external auditory meatus, because of the danger of introducing organisms into the meninges. However, the external auditory meatus should be plugged with sterile cotton, possibly saturated with alcohol. Peet[42] believes that the external auditory canal should be mechanically cleansed of blood clots and wax, following which the entire canal is filled with 3½ per cent tincture of iodine. This is allowed to drain out and a sterile dressing applied to the ear. He warns against plugging the external auditory canal. In those cases in which there is a compound fracture or in which there is an injury to the scalp without injury to the underlying bone, active therapy is of utmost importance. As emphasized by Cushing[43] during the World War in compound fractures, especially those following gunshot injuries, the treatment consists of debridement, removal of the traumatized cranial tissue by means of a suction, following which the wound is tightly closed. Blahd,[28] Bower,[44] Connors,[12] and Weaver[40] advocate debridement in compound fractures and in scalp wounds. Weaver[40] is especially emphatic in emphasizing the necessity of debridement, because he considers wounds of the scalp as potential brain abscesses.

The frequently employed use of morphine and other narcotics in acute craniocerebral injuries is mentioned only to be condemned. In acute craniocerebral injuries such drugs should never be used unless the patient is uncontrollable. Because of their depressing effects on the cerebrum, symptoms may be masked. Weaver[40] also believes that morphine should not be used for severe headache, because the drug depresses respiration. McClure and Crawford[3] state: "In the early stages we do not use morphine as a sedative or homatropine as mydriatic for fear of masking important signs." Bagley[29] prefers coal tar products and bromides in preference to morphine for the control of restlessness and delirium. According to Fay,[11] "Morphine or its derivative should never be given unless other sedatives fail, for there usually ensues respiratory difficulty due to intracranial pressure and edema with additional depressor effect of the narcotic." In the presence of restlessness, however, he advises the use of sodium luminal, chloral or bromide in order to secure relaxation so that the danger of hemorrhage is minimized.

Repeated Lumbar Punctures

As early as 1905 Quincke[74] emphasized the importance of the determination of the cerebrospinal fluid pressure and stated that the best results in the treatment of acute craniocerebral injuries was obtained by lumbar drainage. Rawling[75] was of the opinion, however, that in spite of the apparent advantage of lumbar drainage it is of little value in reducing intracranial pressure. More recently, however, due largely to the work of Jackson[22] and Munro[63] the advisability of lumbar puncture in the treatment of acute craniocerebral injuries has been especially stressed. In 1922, Jackson[22] reported 100 cases of acute cranial injury in which cerebrospinal fluid pressures were determined and which were treated by repeated lumbar punctures. He advocated performing lumbar punctures at intervals of six to twenty-four hours. Fay[11] believes that lumbar punctures should be performed as often as a rise in pulse pressure and respiratory

changes may indicate. Munro[63] treated 60 cases of acute craniocerebral injury by lumbar puncture alone with only 7 deaths, a mortality of 12 per cent. Green,[8] Worster-Drought,[76] McCreery and Berry[41] believe that repeated spinal drainage is of more value than the use of hypertonic solutions in the severe cases. They have not hesitated to remove slowly enough fluid to lower the spinal fluid pressure to 10 mm. of mercury. In none of their cases did this require the removal of more than 50 cc. of fluid. Bagley[29,77] stresses the importance of not performing spinal drainage in those cases in which pure blood is present within the subarachnoid space. He believes that in this type of case it is better to wait until the blood becomes mixed with the cerebrospinal fluid before attempting spinal drainage as the prognosis in the former case is extremely grave. Holbrook,[9] McClure and Crawford[3] are less radical, remove smaller amounts of fluid, and do not decrease the cerebrospinal fluid pressure to such a degree.

Repeated lumbar punctures are of value in acute craniocerebral injuries, not only because the cerebrospinal fluid pressure is decreased, but also because of the removal of any blood which may be present in the subarachnoid space. As mentioned before, blood produces a sterile meningitis and is frequently responsible for late sequelae. Fay[11] believes that repeated lumbar punctures are necessary for a period of ten days, when blood is present in the spinal fluid, because it will take this length of time before all the red blood cells are hemolyzed. He also is of the opinion that spinal drainage is less necessary in those cases in which the spinal fluid contains no blood. Repeated spinal punctures in the treatment of acute craniocerebral injuries have been used successfully by the following authors: Trotter,[4] Heuer,[72] Thorning,[45] Fay,[11] Demmer,[78] Symonds,[27] Gage,[62] and the author.

Hypertonic Solutions

In 1919 Weed and McKibben[79] demonstrated that cerebrospinal fluid pressure and brain bulk could be influenced by the intravenous injections of hypotonic and hypertonic solutions. They showed that cerebrospinal fluid pressure experimentally could be markedly decreased by the intravenous injection of hypertonic solutions. Haden[80] was the first to apply this principle clinically. He employed hypertonic glucose solution intravenously in a case of cerebrospinal meningitis with good results. Cushing and Foley[81] demonstrated that cerebrospinal fluid pressure could be decreased by the ingestion of hypertonic solutions. Sachs and Belcher[82] were able to relieve a patient with a brain tumor and with increased intracranial pressure by the intravenous injection of hypertonic sodium chloride solution. Foley and Putnam,[83] in 1920, showed that the introduction of hypertonic solution into the intestinal tract would produce similar but less marked results. Sachs and Malone,[84] working experimentally, were able to decrease the brain volume in a dog following the intravenous injection of a 30 per cent chloride solution. Within ten minutes after the administration of the solution a change was noted, and a maximum was reached in forty-five to sixty minutes. They found that the rate of injection could exceed 1 c.c. per minute, otherwise there would be a fall in blood pressure and respiratory disturbance. Peet[42,85] believes that the intravenous administration of hypertonic sodium chloride solutions causes toxicity and prefers the use of hypertonic glucose solution. Dowman[86] recommended the intravenous injection of hypertonic solutions in increased intracranial pressure and also advised the repeated administrations of magnesium sulphate by mouth. Ebaugh and Stevenson[87] showed that the intracranial tension could be better controlled by the intravenous injection of hypertonic glucose solutions than hypertonic Ringer's solution. The decrease in intracranial pressure was more gradual following the use of glucose, but no subsequent rise was noticed even after eight hours and forty-

five minutes. Following the use of hypertonic Ringer's solution, however, the maximum fall in cerebrospinal fluid pressure was attained in one and three-quarter hours, the pressure returning to normal in three and a half hours. Foley[88] showed that following the intravenous injection of a hypertonic sodium chloride solution that not only was the cerebrospinal fluid pressure diminished, but also that there was a decrease in the brain and cerebrospinal fluid volume. Fay,[89] in 1923, advocated the use of magnesium sulphate by rectum and states that the effect becomes pronounced within an hour. He employs 1½ oz. of magnesium sulphate in 8 oz. of water. He believes that this is better than the administration of sodium chloride by mouth in that it causes no vomiting and no distress. He also states that sodium chloride is dialyzable and an increased chloride content of the blood leads to secondary tissue retention with a rapid return of symptoms after its administration. Magnesium sulphate, however, is non-dialyzable and produces a rapid dehydration of the blood plasma by excretion of fluid into the intestinal wall. Fay[90] was able to demonstrate experimentally that magnesium sulphate is about twice as efficient as a dehydrating agent in the intestine as is sodium chloride. He[11,91] emphasizes the importance of restricting fluids during the dehydration therapy, but warns against its use in shock and against "over dehydration." Dowman,[86] in 1922, recommended the use of magnesium sulphate both by mouth and by rectum in cases of increased intracranial pressure. Since this time it has been used extensively by many authors, especially the rectal administration which has the advantage that the patient is little disturbed, its effect is prompt, and there is no danger. Connors,[12] on the other hand, is of the opinion that the administration of magnesium sulphate by mouth is of relatively little value and states that he has discontinued its use. Howe,[92] employing a large number of salts: viz., sodium bicarbonate, sodium sulphate, sodium chloride, calcium lactate, calcium chloride, sodium citrate, sodium tartrate, and dextrose, found that sodium bromide, calcium lactate, calcium chloride, and magnesium sulphate were too toxic to be used intravenously. Sodium citrate, sodium tartrate, sodium bicarbonate were relatively ineffectual, whereas sodium sulphate, sodium chloride, concentrated Ringer's and Locke's, tyrode and dextrose solutions produced satisfactory decompression. Sodium sulphate was not toxic at first, but later caused death. Sodium chloride produced secondary edema, which objection also applys to Ringer's, Locke's, and Tyrode's solutions, although they were less toxic than sodium chloride. Howe[92] found that dextrose was the only one of the group that was non-toxic and produced a satisfactory decrease in the cerebrospinal fluid pressure. Henschen[21] advocates the administration of magnesium sulphate either by mouth or per rectum, as well as the intravenous injection of hypertonic saline or glucose solution. Morrissey,[93] on the other hand, believes that relatively little decrease in pressure can be accomplished by the use of magnesium sulphate, but believes that hypertonic salt solution given intravenously has a definite action in reducing intracranial pressure. Glucose in a 50 per cent solution is the best dehydrating agent which can be employed intravenously. Its action although slightly less prompt than that of hypertonic sodium chloride solution, is, however, more lasting, (according to Fay,[11] from one to four hours). Its intravenous use is also much safer than that of the hypertonic sodium chloride solutions. From 50 to 100 c.c. of a 50 per cent glucose solution may be administered intravenously from every six to eight hours, depending upon the severity of the cerebral edema. Thomas[73] recommends the administration of from 100 c.c. to 300 c.c. of 50 per cent glucose in a day. In contrast to the hypertension of the cerebrospinal fluid which is usually associated with cerebral injuries, rarely a hypotension may occur. This phenomenon was first emphasized by

Leriche[94] in 1920. In the 414 instances in which lumbar puncture was done in McCreery and Berry's[41] series, a hypotension of the cerebrospinal fluid was found in 12 cases. Leriche[94] advocated the use of hypotonic solutions and even sterile water intravenously in the treatment of patients with a decreased cerebrospinal fluid pressure. Excellent results in these cases have been obtained with this therapy by Henschen,[21] Mallet-Guy and Etienne-Martin.[95] The latter authors believe that in contrast to hypertensive disturbances, which produce symptoms for a relatively short period of time, the hypotensive disturbances cause prolonged complications and distressing sequelae. Persisting headaches (usually in the occipital region), asthenia, and a state of nervous irritability are frequently present.

Operative Treatment

Even though at the present time the treatment of acute craniocerebral injuries consists largely of conservatism, there are certain definite cases in which operation is indicated. Operation is indicated in those cases with scalp wounds, compound or depressed skull fractures, and localized intracranial hematomata. According to Fay:[11]

> Operation is indicated under only two conditions: (a) a compound fracture of the skull (with or without comminution), where simple cleansing of the wound is required, (b) extradural or subdural hemorrhage (middle meningeal or venous), where progressive focal signs are present. Rarely, if ever, does a depressed fracture require elevation during the early days following injury unless this depressed fracture produces local or dangerous pressure symptoms.

Peet[42] is of the opinion whenever a diagnosis of fracture of the cribriform plate can be made, as indicated by a discharge of spinal fluid from the nose, that an operative procedure is indicated. Patients with extradural hemorrhage or even intradural localized hematomata with focal symptoms and signs should be operated upon in order to evacuate the blood clot and also to secure hemostasis. Most authors believe that contusion of the brain as such should not be operated upon, however, Arnaud and Albert Crémieux[16] are of the opinion that localized ecchymosis of the cerebral cortex, surrounded by an area of edema, should be given the advantage of a decompressive operation. Bagley[29] is emphatic in stating that operative procedures should not be performed in cases with hemorrhage unless a clot has formed. If a clot has not formed, the operation will favor further bleeding. In those cases in which it is impossible to control the increased intracranial pressure by spinal tap and the intravenous use of hypertonic solutions, decompression may be indicated in order to relieve the increased cerebral pressure. Bower[44] believes that, if after the second aspiration of spinal fluid, there is an increase in the cerebrospinal fluid pressure of 20 mm. of mercury and no improvement has occurred, operation is indicated.

Prognosis

Prognosis in acute craniocerebral injuries varies considerably and is dependent upon the extent of the injury and the type of therapy instituted. When considering prognosis, it is essential to differentiate between prognosis as to life and prognosis as to complete restoration of function. Munro[63] collected 2908 cases from the literature in which there was a mortality of 37.8 per cent. He reports a mortality of 19.6 per cent in the Boston City Hospital series. The mortality rates as reported by various authors are as follows: Jackson,[22] 25 per cent; Thorning,[45] 23 per cent; Blahd,[28] 33 per cent; McCreery and Berry,[41] 39 per cent; McClure and Crawford,[3] 14.7 per cent; and Fay,[11] 20.8 per cent. In Fay's[11] series of 48 cases the mortality rate of those patients who survived the sixth hour after admission was 10.4 per cent. Fay[11] believes that the reduction in the mortality rate in those cases which survive the six-hour period is due to improvement in treatment of these cases,

especially the introduction of the more conservative measures.

Undesirable effects and sequelae frequently follow cerebral injury and may produce very definite disability. English[96] states that there is an element of truth in the statement, "A man is never the same after a head injury." From his experience he believes that there is some degree of mental impairment in about 10 per cent of patients. He feels that all individuals with cranial injuries should be given the advantage of a prolonged mental rest after the injury. This period of rest he believes should be twice as long for intellectual workers as for manual workers. Fay[34] has found that patients who have a relatively mild head injury frequently develop, after their immediate recovery, intermittent headaches, irritability, loss of memory, and ambition. He believes that the ultimate recovery of a patient often depends upon the treatment instituted during the first seventy-two hours. Employing encephalography he[34] has been able to demonstrate a marked cerebral atrophy, even the absence of neurological signs in many of these patients. The degree of cerebral atrophy is often out of proportion to the severity and the location of the lesion. The areas of cerebral atrophy are usually found in the frontal and parietal portions of the brain, whereas the temporal and occipital regions are not involved. This atrophy, according to Fay,[34] is the result of an abnormal stagnation of cerebrospinal fluid in the subarachnoid space, caused by the "blocking" of the Pacchionian bodies with blood present in the cerebrospinal fluid. Gerhartz[97] has seen cases in which there was prolonged increase in cerebrospinal fluid pressure, which he believes is due to a chronic traumatic meningitis and is also a result of blood in the subarachnoid space. Hoag[98] states that following head injuries about 80 per cent of patients have a continuation of symptoms. Eight per cent of his patients showed decidedly psychotic symptoms; only 10 per cent showed no subjective complaints. The most prominent symptoms in his series were headache and vertigo, which continued occasionally for a long period of time. Less common complaints were tremor, insomnia, nausea, cardiac palpitation, and inability to concentrate or use the memory, or to stand the stress of exertion. Sharp[99] stated that in 68 per cent of a group of head injuries which he was able to follow had sequelae, consisting of headache, change in personality, depressed or excitable conditions, and exceptionally convulsive seizures. More than 50 per cent of these patients had increased intracranial pressure. At operation Sharp[99] found no gross lesion, but a whitish connective tissue residue could be seen along the supracortical veins and sulci, which he believes produced a partial blocking of the absorption of the cerebrospinal fluid. Of McClure and Crawford's[3] patients, 64.2 per cent were discharged as apparently cured and did not return; 17.7 per cent were discharged with unfavorable symptoms, and 3.4 per cent were either transferred or left against advice. In an attempt to follow up those patients who had disappeared from observation, questionnaires were sent to 229. Only 76 (33.2 per cent) replied. Of this number, 71.1 per cent suffered or were still suffering from one or more unpleasant sequelae. These sequelae in order of their frequency were: vertigo, headache, fatigability, nervousness, irritability, impairment of memory, mental changes, paralyses, and convulsions. From the analysis of their series, McClure and Crawford[3] consider the prognosis best in children, as there were fewer sequelae and a greater percentage of recoveries. Children, however, are more apt to develop such sequelae as epilepsy and mental retardation. McClure and Crawford[3] emphasize the importance of guarding the prognosis until at least six months or a year have passed. Kasanin[100] emphasizes the importance of personality changes in children following trauma. In addition to personality changes there may be headache, giddiness, tinnitus, and memory defects. of 80 patients with cerebral contusion

reported by Symonds,[27] 22 per cent made a complete recovery, 46.5 per cent were able to return to light work, and 10 per cent were totally incapacitated. Worster-Drought[76] believes that the percentage of complete recoveries following major cerebral contusion is less than 22 per cent. He has seen epilepsy occur three to four years after the accident and states that it may occur much later. He believes that head injuries of the left frontal region are the most serious as regards prognosis with respect to mental changes. Trotter[4] frequently found such symptoms as headache, dizziness, mental change, occurring after head injuries, which were due to a persistent elevation in increased intracranial pressure. Ritter and Strebel[23] found that of their patients, 38.7 per cent with cerebral concussion and 44.7 per cent with concussion of the medulla oblongata were able to resume full work.

In an attempt to relieve the post-traumatic headache and dizziness, Penfield,[101] Gardner,[102] and Kasanin[100] advocate the lumbar insufflation of air. Penfield[101] reports 7 patients having post-traumatic headache and dizziness, all of whom were relieved of their headaches. Six complained of vertigo, which was also relieved. Gardner,[102] in examining encephalograms in a series of 33 cases of so-called idiopathic epilepsy and post-traumatic sequelae, found the following common abnormalities: (1) dilatation of a portion of the subarachnoid space with apparently resulting brain atrophy; (2) dilatation or distortion of a portion of all the ventricular system, and (3) an obstruction of a portion of a subarachnoid space which is probably the result of abnormal pia arachnoid adhesions. In an analysis of 19 patients in whom sequelae followed cranial trauma and in whom a clinical diagnosis of idiopathic epilepsy was made, Gardner[102] found the following results following the therapeutic insufflation of air. Of 19 patients with post-traumatic epilepsy there was an average "follow-up" of nine months in 12; 4 of these had no further attacks, 5 were apparently improved in that the attacks were less frequent, in 1 the attacks were unchanged, and in 2 the attacks were more frequent after encephalography. In 12 patients suffering from headaches, 2 were greatly improved, 8 were improved, 1 showed no improvement, and 1 was worse. In 6 suffering from tinnitus, 2 were entirely cured, 2 improved, 1 showed no change, and 1 was worse. Of 8 patients with vertigo, 2 were entirely relieved, 3 improved, and 3 showed no change.

SUMMARY

Injuries to the cerebrum are of paramount importance in trauma to the head. Unfortunately, in the past too much attention has been paid to injury to the cranial vault rather than to injury to the cerebrum itself.

Craniocerebral injuries should be classified into two main groups: (1) those with cerebral injury which may be associated with or without cranial injury, and (2) those without brain involvement. In the first group are concussion, edema, contusion, laceration, and hemorrhage. In the latter group are scalp wounds and the various types of skull fractures. Concussion of the brain is a justifiable diagnosis as a clinical entity if it is kept in mind that concussion is a physiologic and not a pathologic lesion. It is characterized by immediate unconsciousness, associated with headache, vomiting, and occasionally circulatory and respiratory disturbances. Characteristically, the clinical course is such that the patient recovers completely within from twenty-four to forty-eight hours.

Edema of the brain is the most important pathologic lesion as it is the most frequently encountered. The extent of edema varies considerably. Edema is the most frequent cause of increased intracranial pressure. Not infrequently a vicious circle is produced; i.e., as a result of the edema there is interference with the venous return, which causes a diminished absorption of the cerebrospinal fluid, which in

turn produces an increased intracranial pressure. Contusion and laceration are found in the more extensive injuries of the cerebrum and vary largely in degree. Lacerations are usually associated with lesions of the cranium, whereas contusions frequently are not.

Hemorrhage is of two types, intradural and extradural. Associated with every cerebral injury, from the slightest contusion to the extensive laceration, there are varying degrees of hemorrhage. Intradural hemorrhage is a result of injury to the brain substance, whereas extradural hemorrhage occurs as a result of injury to the middle meningeal artery or rarely to the lateral venous sinus. Subdural hemorrhage is of importance because of sequelae which may develop, such as sterile meningitis, abnormal accumulation of cerebrospinal fluid, which may subsequently lead to cerebral atrophy, and localized cystic changes occurring in hematomas. Extradural hemorrhages occur relatively infrequently, but are of surgical importance as they are amenable to surgical intervention. Scalp wounds are of great importance, because they represent potential brain abscesses, as organisms may gain entrance to the meninges.

Fractures of the skull are divided into two main types, those of the vault and those of the base. In the autopsy series fractures of the base occur much more frequently than fractures of the vault, whereas in the clinical series fractures of the vault are recognized more frequently. This discrepancy is probably due to the fact that fractures of the vault are more readily recognized roentgenologically than are fractures of the base. Simple and comminuted fractures of the vault are of no significance clinically. Depressed fractures of the vault are of significance, because of the cerebral injury which may be associated with it. Fractures of the base are of great significance, because almost invariably they are compound fractures in that fracture extends into the nose, nasal accessory sinuses, mastoid process, or middle ear. Compound fractures of the vault are of importance because of the danger of infection.

As regards diagnosis the history, especially the history of unconsciousness, is of extreme importance. Pulse and respiratory rates are of little value in diagnosing cerebral injury early in the condition. They are of prognostic value. Careful examination of the entire body, especially that of the nervous system, is of great importance. Pupillary changes are of relatively little diagnostic value, but are of great prognostic value. When these changes are unilateral, they may be of localizing value. Examination of the eyegrounds is of little importance as far as an indication of increased intracranial pressure is concerned. Blood pressure determinations are of little value except in shock, as whenever hypertension is obtained, it is indicative of an advanced lesion.

Of greatest importance as regards the diagnosis of acute craniocerebral injuries is spinal tap with manometric determination of the cerebrospinal fluid pressure. It is the earliest and most reliable method of determining increased intracranial pressure. The finding of blood in the cerebrospinal fluid is of utmost importance, because of the subsequent sequelae which may develop because of the blood in the subarachnoid space.

The treatment of acute craniocerebral injuries is one of conservatism. Non-operative treatment is indicated unless there are very definite indications for operative interference. As most patients with acute craniocerebral injury are in shock, it is imperative to treat the shock first. This is best done by the administration of hypertonic (50 per cent) glucose solution intravenously. As soon as the patient has recovered from shock, every effort must be made to prevent and combat the development of cerebral edema. This is best accomplished by the use of hypertonic solutions by mouth, by rectum, or intravenously. Magnesium sulphate is admin-

istered either by mouth or by rectum after the patient has recovered from shock, and 50 per cent glucose solution is used intravenously. Repeated spinal tap with drainage of the cerebrospinal fluid is indicated in cases of cerebral hypertension. Operative procedures are indicated in scalp wounds and compound fractures, which require debridement and primary suture. Depressed fractures should be elevated. A small percentage of those patients who do not respond to the conservative treatment should be given the advantage of an operative decompression.

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*For References 1–70 see May issue, p. 240.

AN UNCOMMON CONGENITAL MALFORMATION

WITH CASE REPORT*

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BABY girl: born the morning of November 27, 1929, precipitate labor before mother's arrival at hospital.

FIG. 1.

Baby to all appearances normal. Nurse reported passage of meconium during first twenty-four hours. Nursed well. On the third day abdomen was moderately distended and an enema was given without result. On the third day milk of magnesia and high enemas were administered without results. Fourth day 8 c.c. of castor oil. No vomiting. Baby nursed well. On the eve of seventh day it vomited; vomitus had strong odor but not fecal; during night vomitus undoubtedly fecal. An attempt at proctoscopic examination unsatisfactory, except to determine patency of anus. At noon, December 5, an exploratory laparotomy was made. Preoperation diagnosis: Intestinal obstruction, in a girl baby nine days old, with history of normal bowel movement during first twenty-four hours, with no subsequent movements. For past twelve hours patient has had two or three vomiting spells, vomiting apparently feces.

Under ether a midline incision above umbilicus was made and the rectum, sigmoid, and entire colon and greater part of ileum were found to be very small and cord-like. The contents had the feel of putty. The jejunum was considerably distended. The intestine from the jejunum was examined down to the cecum, and its diameter estimated at 10 mm. and the colon from cecum to lower rectum had a diameter of 5 mm. The condition being inoperable, wound closed, and patient died December 7, 1929.

The accompanying photograph by the Signal Corps, United States Army, Hawaiian Department, shows the normal slightly distended jejunum and the ileum and colon for comparison. The hole in the ileum near cecum was made at autopsy. The entire intestinal tract was patulous.

ABDOMEN

Autopsy record follows:

"On opening abdomen no free fluid or adhesions found. All organs are in normal position.

GASTROINTESTINAL TRACT

"The stomach and duodenum are about normal size. The upper jejunum is somewhat distended and bluish red in color. The ileum and entire colon are pale in color and small. The ascending, transverse and descending colon measure 16 in. in length. The sigmoid colon and descending colon are small, being between 5 and 6 mm. in diameter. On opening, canal is patent, will admit a very small probe, and contains a small amount of grayish, sticky mucoid-like material. The cecum is slightly

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larger than the descending colon, contains more material similar to sigmoid and measures 9 mm. in diameter. The ileum is about 8 mm. in diameter. Thirty-two inches above ileocecal valve the intestines are somewhat constricted, being about the size of sigmoid, then there are 6 in. that approach normal size; and again there is a constriction. The upper jejunum measures 3 cm. in diameter and contains normal appearing thin, yellowish feces. Other organs not removed. Those in abdomen appear normal.

ANATOMICAL FINDINGS

1. Malformation, congenital, colon and ileum (narrowing).
2. Intestinal obstruction, due to 1.

MICROSCOPICAL SECTIONS

"Microscopical sections from sigmoid colon, ascending colon and ileum show mucosa present and apparently normal. Two muscle coats present, which also appear normal, but on stretching to the size of normal gut the muscle and mucosa are extremely thin, and evidently lack power"—H. R. Livesay, Major, Medical Corps.

The reason for reporting this case is first, its rarity. Mummery, in "Diseases of Rectum and Colon," states:

Congenital abnormalities of the colon itself are very rare and as a rule, when found are associated with congenital abnormalities of other parts. The colon or some part of it may be completely absent or represented by only a fibrous cord. Some form of atresia is the most common. Atkins described a case where the whole colon and rectum were rudimentary and about the thickness of an ordinary quill, there being, however, a small lumen throughout the entire colon—his case was associated with imperforated anus.

Second, the deceptive history of obstruction as manifested by normal meconium bowel movements during first twenty-four hours, which can now be explained by the fact that this was not an obstruction due to an atresia, but an obstruction due to hard inspissated milk curds, in the normal lumen with musculature and mucosae so undeveloped that the inspissated curds could not be forced along the narrowed canal, thus obstructing further passage of meconium.

In the original picture the lumps of curd can be distinctly seen through the bowel wall.

I am indebted to Major Norman McL. Scott for the history of this case.

CHRONIC CONSTIPATION

RATIONAL EXPLANATION OF THE SYMPTOMATOLOGY, WITH SUGGESTIONS FOR TREATMENT*

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THE object of this paper is an analysis of the symptomatology and the mechanism by which the symptoms are produced in chronic constipation and chronic colitis. This necessitates a more or less general discussion of this disease.

Alvarez and others have shown the small intestine has three types of movements.

1. Rhythmic movements due to contractions of the circular muscles. These occur more rapidly near the pylorus and diminish in frequency the nearer they approach to the ileocecal valve.

2. Pendulum movements due to contractions of the longitudinal muscles.

3. Rush movements due to contractions of both longitudinal and circular muscles.

The first two serve to mix the intestinal contents while the third carries the mixture toward the cecum.

It has been shown that the colon also has rhythmic movements but they occur much less slowly than in the small intestine. In addition from time to time mass movements occur. These will push a bolus of stool from the hepatic flexure clear into the rectum at which time a desire to defecate is produced.

Constipation is an insidious trouble seldom descending upon the individual with sufficient suddenness to permit one to set a definite time of onset. In all probability improper evacuation has been present a long time before sensations rise to the patient's consciousness, resulting in symptoms.

Anything that interferes with rhythmic or mass movements of the large intestine or with the sensitiveness of the anal canal will serve to delay evacuation. Hence we must look to the nervous system for the onset of constipation. Almost all have had the experience of passing from a state of normal evacuations to one of acute constipation with no change in their lives other than the excitement of a train ride. Todd has shown a diminution of rhythmic movements of the colon in students during an examination. It is reasonable that excitement or nervous tension would produce a contraction of all the alimentary sphincters except the cardia inasmuch as they are supplied by the sympathetic nervous system. Thus undue excitement by causing a contraction of the rectal sphincters could keep the bowels from moving regardless of the entrance of stool into the rectum causing the desire to defecate.

Reasoning from this, one can appreciate how the increased nervous tension of our present civilization can cause a slight delay in the beginning to be followed after a few months or years by chronic diminution of rhythmic contractions and mass movements of the colon with a state of continuous increased contraction of the rectal sphincters, thus causing the stool to be retained in the colon from twenty-four to forty-eight hours longer than it should remain.

This delay and undue contraction of the sphincters could well produce dilatation of the hemorrhoidal veins with irritated pockets about the rectum. Nor would it take a great flight of the imagination to conceive a colitis or at least an irritable mucous membrane resulting from the retention of stool for so many hours after it should have been deposited in the toilet.

Alvarez has pointed out a law that stimulation at any point tends to hold back material coming down from above. One can readily see then that because of the irritability of the rectum and colon

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there would not only be a delay in this region but it would extend to a greater or less degree clear to the cardia. Again, adhesive bands, congenital or acquired, may act as irritating points delaying peristalsis thus causing stool retention and resulting mucous membrane pathology. Malformations of the colon may cause the same results. It is at this period that symptoms have become so manifest a physician's advice is sought.

There are three groups of symptoms produced by these conditions:

1. Those due to reversed peristalsis.
2. Those due to intestinal distention.
3. Those due to toxemia.

It has been shown that if a small portion of the small intestine is injured, reverse ripples will ascend from this area extending even to the cardia. Is it not reasonable then to believe that as a result of colon irritability reverse ripples ascend the small intestine and if marked enough may ascend clear to the cardia, even causing a relaxation of this sphincter thereby letting gastric juice into the esophagus thus producing water-brash and heartburn? The sensation of heaviness and weight in the epigastrium, loss of appetite, and furred tongue can all be explained on this basis. Lycopodium deposited in the rectum at night has been found on the tongue in the morning, having been carried up by reverse ripples during the night. Possibly some of the material found on a coated tongue in the morning has been carried up in the same manner by reverse ripples due to colon irritability. A bad breath and a bad taste could be produced in the same manner.

The feeling of fullness after eating even a small meal, belching, sour stomach, and the gnawing sensation simulating peptic ulcer might well be due to these groups of reverse ripples.

Donaldson working with a group of students upon whom acute constipation was produced found that the symptoms of languor, heaviness in the epigastrium and headache were relieved immediately following a bowel evacuation by an enema to recur immediately following distention of the rectum with cotton. These symptoms which are so common in constipation appear, then, due to rectum and colon distention. Also in this disease flatulency is extremely frequent. If a flatulent patient is observed with a fluorescent screen the gas will be found almost entirely limited to the small intestine. Beyond a reasonable doubt there is no excessive production of gases but an improper absorption of the gases formed in the normal process of intestinal digestion. If good drainage from the colon is established by soothing means, in other words if colon irritability is relieved, flatulence disappears.

The normal mucous membrane of the intestine is so resistant that bacteria and the various toxins present cannot permeate it. However, if this membrane becomes irritated or inflamed the resistance is so lowered that both these substances can pass through into the circulation. It is reasonable to believe that fecal pools due to adhesions or malformations can readily lower the resistance, if not produce actual inflammation of the mucous membrane. It is also reasonable to believe that the mucous membrane of the colon may become irritated if general stasis is present over a long period of time. If in this sort of state the bacterial flora becomes pernicious also, one can readily imagine that substances can enter the circulation producing a long train of symptoms resulting from this chronic toxemia.

In concluding this paper I should like to discuss briefly a rational treatment based upon the foregoing premises.

If irritation and inflammation of a portion of the intestine cause an inhibition of the downward waves and send reverse waves upward then the cure is to remove the points of irritability. Hemorrhoids, rectal pockets, hypertrophied and inflamed Houston's valves as well as contracted rectal sphincters are not only common but some of these are almost universal in any patient suffering from

chronic constipations. Hence the treatment should be begun by removing these factors by surgery or other means.

When this is done relief of the irritated or inflamed mucous membrane should next be sought. This can be accomplished by obtaining proper drainage and by applying soothing applications directly to the mucous membrane.

The two great factors in diets most efficient in this trouble are based on colon distention and upon the principle of poulticing. Diets rich in vegetable roughage, bran, agar and psyllium seed not only produce distention thus stimulating peristalsis, but by producing a bland soft succulent mass act as a poultice to an irritated surface thus relieving the inflammation and irritation.

Instead of bran acting as an irritant and thus stimulating peristalsis, I believe it acts as a soothing mass retaining water and forming bulk. The same thing occurs with the cellulose of vegetable roughage—water is retained and a succulent soothing mass is produced. Agar and psyllium seed are probably the best water carriers and by their bland mushy bulk not only poultice the intestine but stimulate peristalsis. Petroleum oil acts by its lubricating qualities to produce a soothing slippery mass thus hastening evacuation.

It is of extreme importance to continue the use of these substances long after good evacuations are obtained as it takes many months longer to relieve the irritated and inflamed mucous membrane than it does to secure proper drainage and if the irritability of the whole colon is not relieved it is but a question of time until there is a recurrence of symptoms.

Fruits probably act by stimulating intestinal secretions and by changing bacterial flora through their sugar content.

It is also important to obtain nervous relaxation as this in turn relieves sphincter spasm. Colon irrigations, hot applications or any other measures which tend to sedation are helpful for relief of this trouble.

To summarize, then, we have, first, a law indicating that any point of inflammation or irritation in the alimentary canal blocks the waves coming down from above and tends to produce reverse peristalsis.

Second, we believe constipation is due to some area of irritation or inflammation somewhere below the ileocecal valve. This may be a spastic rectal sphincter, rectal inflammation, colitis or adhesions.

Third, the symptoms accompanying chronic constipation are due to reverse peristalic waves, to intestinal distention or to toxemias.

Fourth, the cure of this trouble then, is the removal of these points of irritation or inflammation.

CARCINOMA OF THE PROSTATE:

UNUSUAL METASTASES*

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THIS paper might well have as its text Dr. Osler's well-known dictum, "The difference between a good doctor and a poor doctor is that a good doctor knows how to make a rectal examination." Cancer of the prostate is not as infrequent as has been usually supposed, it being present in over 20 per cent of the cases of urinary obstruction. It is generally accepted that one-third of all cases of cancer of the prostate show bony metastasis when they first consult a doctor, a fair percentage have involvement of pelvic and abdominal lymph glands (not as a rule demonstrable), and a small percentage have vesical metastasis. Hence, at least 50 per cent are beyond the possibility of a cure before the diagnosis is made. We may have well established carcinoma from metastasis in almost any part of the body without the prostate being suspected as the primary site because of the absence of definite urinary symptoms. In many instances extensive involvement of the seminal vesicles and metastases in the bones occur without glandular involvement. The osseous system is eventually invaded in almost every case.

In some cases the bony metastases alone produce symptoms. Many a patient is treated for an osteoarthritis for months before his urinary symptoms develop sufficiently to attract the physician's attention. A residual of urine is then found, along with a cancerous prostate that has already extended to the bones and the lungs. Even then the patient may live for several years with no other treatment than deep therapy. Howard E. Ruggles has had several patients under observation for eleven years.

If a rectal examination was made an integral part of every routine physical examination it is probable that more cancers would be found early. The story of two surgical tragedies resulting directly from failure to make rectal examinations was indelibly impressed upon me as a student. Dr. Harvey Cushing told of an unnecessary brain operation he had done because a rectal examination had not been made and the primary focus in the prostate discovered, and Hugh H. Young of his first cancer case. A man entered the hospital complaining of a swelling of the tibia. A diagnosis of bone sarcoma was made, amputation followed and microscopic sections showed cancer. A rectal examination was then made and the focus

FIG. 1. (CASE 1.) Metastasis in bodies of all lumbar vertebrae, causing backache.

* Read before the American Urological Association, Western Division, at Los Angeles, California, Sept. 19, 1930.

was found in the prostate, with few if any symptoms.

The importance of recognizing various degrees of induration cannot be too greatly emphasized because in carcinoma one almost always finds a third degree induration and such a finding should at once lead to suspicion of malignancy. Occasionally, however, the cancerous prostate is neither nodular nor hard on simple rectal palpation. A cystoscope in the urethra and a finger in the rectum will then be of help, as the stony hard posterior lobe can be felt. Benign hypertrophy is almost never found in the proximal suburethral portion of the prostate, hence an extremely hard layer between the apex and verumontanum may be considered diagnostic of carcinoma.

In all cases where carcinoma is suspected *x*-ray plates of the bones, especially the vertebrae and pelvis, should be made. The metastases are more often productive than destructive. They are indicated by areas of condensation usually multiple, small and closely set, giving a peculiar "spottiness" to the bone.

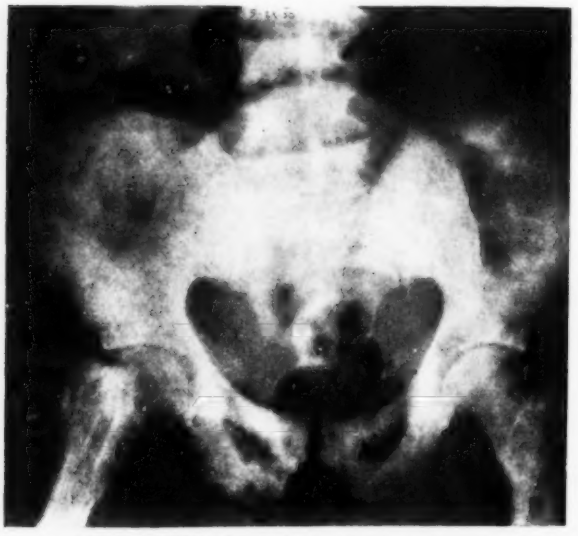

Fig. 2. (Case 11.) Neck of right femur fractured during manipulation for reduction of "sacroiliac slip." Characteristic "spotty" metastases in pelvic bones. Bladder distended to upper border second lumbar; following the withdrawal of 2000 c.c. of urine, with reduction in size of tumor, patient showed signs of distress so 500 c.c. of water were replaced.

Four cases of carcinoma of the prostate, not diagnosed until unusual metastases had appeared, are reported.

Fig. 3. (Case 11.) "Industrial backache" due to vertebral metastases with compression fractures of body of twelfth thoracic, first and second lumbar vertebrae.

Case 1. (No. 1886) Unrecognized fracture of right femur following frequent manipulation of so-called sacroiliac slip. L. B., age fifty-three, Italian, laborer. On Feb. 12, 1930, while performing his regular duties he felt a pain across the lower back. The following morning he noticed "rheumatism" in his arms, shoulders, neck, back and right leg. Routine daily treatments were given him by his family doctor, but as the pain persisted he came to San Francisco on April 1 to consult a specialist. A diagnosis of sacroiliac slip was made, and this was "reduced" by manipulating the right leg and he was sent home to an osteopath who continued treatments. Subsequently, he was hospitalized four times in San Francisco.

On May 29, because of abdominal pain, he was examined by a consultant who discovered an abdominal tumor held down by a tight sacroiliac belt. I then saw him and found a bladder extending above the umbilicus and an overflow incontinence. The prostate was small and stony hard. There was a marked

anemia; hemoglobin 45 per cent, red blood corpuscles 2,370,000; white blood corpuscles 7400. *X*-ray plates were made and the roentgenologist (J. R. O'Neill) reported, "extensive osteoplastic metastases in all bodies of vertebrae (Fig. 1) of lumbar spine and pelvis. These changes are characteristic of metastatic lesions in the malignant prostate; also, pathological fracture through neck of right femur" (Fig. 2). ture through neck of right femur" (Fig. 2). Death occurred on July 29, 1930, following the spontaneous rupture of an ischiorectal abscess. *Comment:* No symptoms attributable to the prostate or bladder were noticed by the patient until about three months before death.

Case II. (No. 1953) "Industrial backache" due to metastases in vertebrae from cancer of prostate. (Reported through courtesty of Dr. Ralph Swarts.) C. J., aged sixty-five, single, laborer. On Nov. 9, 1929, while at work, the patient stumbled and fell over backward striking his head on the ground. He continued with his duties throughout the day but the next morning his hips were so sore he could hardly get out of bed. He spent about a month in each of three hospitals and the attendants in the last institution eventually decided that he was a malingerer. His only complaint at this time (Feb. 5, 1930) was "a pain in my right thigh that starts just above my right knee and extends upward to the groin." Examination by the attending physician showed nothing of interest except an enlarged liver, lumbar spine flattened, motion restricted, right sciatic nerve tender, practically no adduction of left femur. Local *x*-ray diagnosis was "multiple arthritis" (Fig. 3). The film was then sent to San Francisco and Lloyd Bryan reported, "The film shows irregular mottled increase in the bone density with small areas of rarefaction involving the eleventh and twelfth thoracic vertebrae, the entire lumbar spine and the upper sacral segments. There is compression of the body of the twelfth thoracic and first and second lumbar vertebrae. The second lumbar is compressed and is narrowed on the right side. Conclusion: Pathological fracture of the twelfth thoracic and first and second lumbar vertebrae occurring in a metastatic malignancy with a primary in the prostate."

The local physician did not accept this diagnosis so arrangements were made for a trained pathologist to go from San Francisco to perform an examination and get the prostate, in case of death. However, on April 25, 1930, an autopsy was performed by the

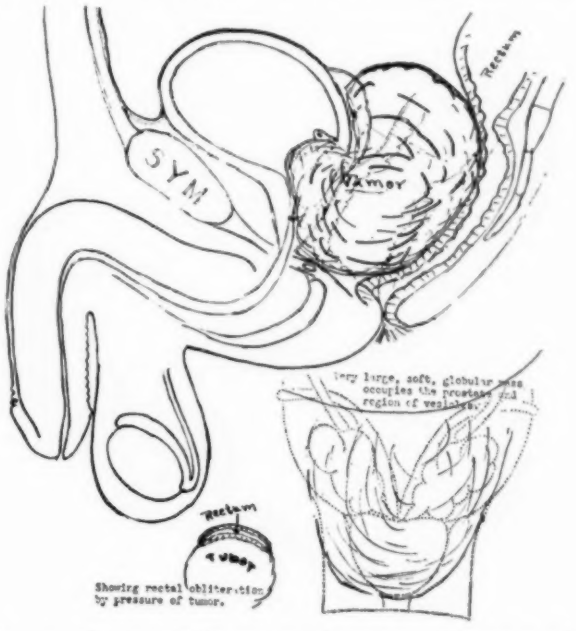

Fig. 4. (Case III.) Sarcoma of prostate. Diagram of findings at examination.

physician himself, no microscopic sections were made, no specimens saved, no primary focus was reported, but "the eleventh and twelfth thoracic, first, second and third lumbar bodies were very much softened and bore macroscopic evidence of a carcinoma." *Comment:* A sixty-five year old man with no urinary symptoms and an unexplained pain in the back that prevents him from working should be suspected of having bony metastases from carcinoma of prostate. Furthermore, a negative rectal finding made by an untrained finger is worthless.

Case III. (No. 868) Sarcoma (or anaplastic carcinoma) of the prostate. J. E. A., aged sixty-two, married, examined Oct. 26, 1926. Nocturia two times during past eighteen months; catheterized for acute retention five times in past five months. Stream had been getting smaller, was of poor force and there was slight hesitancy but no dribbling. No hematuria until day of examination. *Examination:* Prostate was very large and globular encroaching upon the rectal space so that with great difficulty a finger was introduced. It was very elastic and had the sensation of a cyst (Fig. 4). A cystoscope was introduced with great difficulty, the end having to be depressed almost against

the table and this put a great pull on the suspensory muscle. There was a residual urine of 60 c.c. and a bladder capacity of 350 c.c., grumous material. Small lobules of benign prostatic hypertrophy were removed and routine prostatectomy closure, with urethral

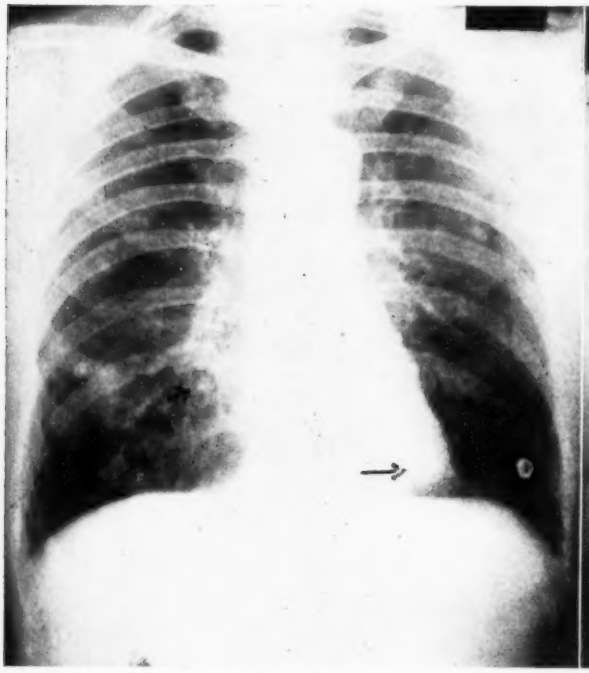

Fig. 5. (Case III.) Early pulmonary metastasis.

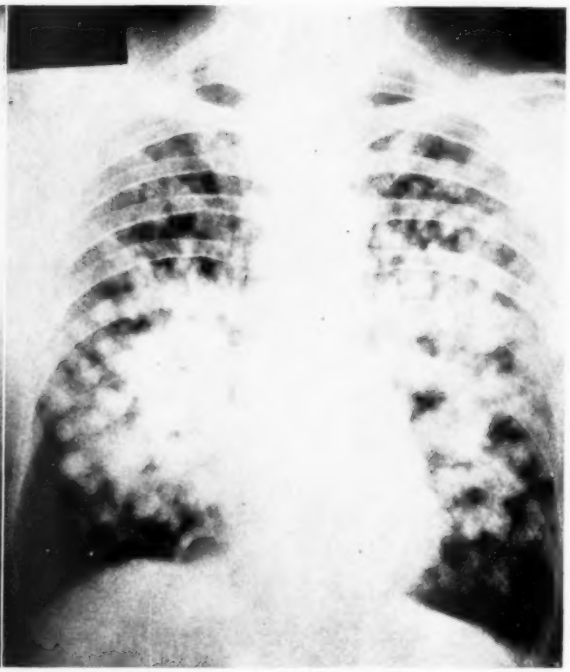

Fig. 6. (Case III.) Condition found three years later, lungs not having been exposed to deep therapy in interim.

moderate degree of trabeculation; trigon elevated in such a way that neither of the ureteral orifices could be seen. Anterior and lateral clefts were not marked. When an attempt was made to feel the thickness of the prostate with the instrument in the urethra and finger in the rectum, it was found that the finger had to be turned down so that the coccyx was palpated instead of the back of the cystoscope, it being impossible to rotate the finger so as to turn the tip upwards. Tentative diagnosis: Sarcoma of the prostate.

Because of the patient's yellow color simulating jaundice he was thoroughly examined by an eminent internist before the operation, but *x*-rays of the chest were not made. This physician was rather insistent that we were dealing with a cyst and that it should be aspirated through the rectum. On Nov. 8, 1926, a perineal exposure was made by Young's technique. It was difficult because of the adherent rectum. As the rectum was being dissected away from the prostate the sac tore and there was a gush of what appeared to be dark colored blood, which contained masses of

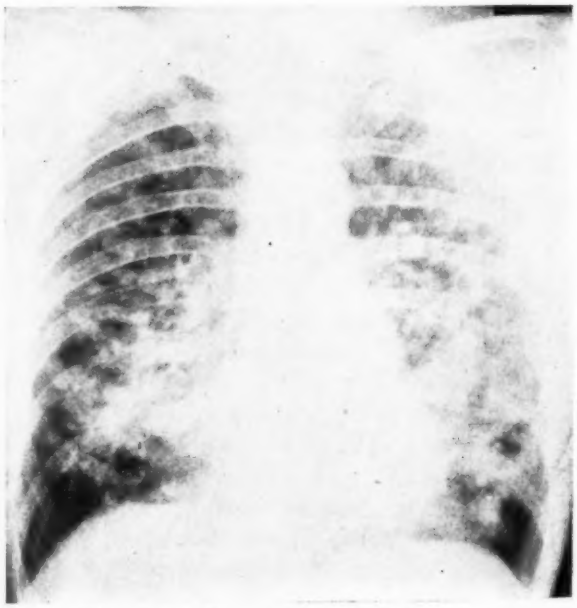

Fig. 7. (Case III.) Six months after Fig. 6, one course of deep therapy in interim. There have never been any subjective pulmonary symptoms.

catheter, carried out. Sections of the semi-liquid pus-like material showed "densely

crowded atypical cells supported by a very delicate stroma consisting almost entirely of capillary blood vessels. The cells adjoining some of the capillary spaces show palisade-like arrangement. Mitotic figures were quite frequent. The malignant character of the new growth is well established, probably it will have to be classified as an endothelioma (C. O. E. Werner)."

The *x*-ray showed no metastases to bones, but "both lung fields (Fig. 5) are diffusely sown with an innumerable number of small faint round rather densely contoured shadows more numerous toward the bases, the largest of which lies just below the heart—diffuse carcinosis (J. Rehfisch)."

Deep therapy was given to the pelvis, the roentgenologist, however, advising against treating chest unless the pelvic tumor responded as he considered the case otherwise hopeless. (Several years before a roentgenologist made a grave mistake on a member of the family, both as to diagnosis and prognosis, and as a result it was very difficult to make them accept a serious view of this case.)

There was no recession in the size of the pelvic mass, but the patient regained his strength and returned to his regular duties. On March 2, 1928, the rectal mass was as large as before operation, and as he was called to Washington, D. C., on business a week later, I arranged for him to go to Baltimore to see a urologist, and take some deep therapy treatments, but he did neither. He was next seen on July 7, 1928, complaining of hematuria. Cystoscopy showed marked invasion of the bladder by the tumor.

On Dec. 3, 1929, he reported that his wife had put him on chiropractor McCoy's diet of milk and orange juice (as recommended in the daily press) for stomach trouble. It relieved his gas but reduced his weight until he was very weak. (RBC 3,500,000.) He then consented to take another course of deep therapy. On Dec. 4, 1929, the roentgenologist reported (Fig. 6). "There are rounded smooth coin-like shadows fairly uniformly distributed throughout both lung fields. These are slightly more numerous in the base of both lungs and are due

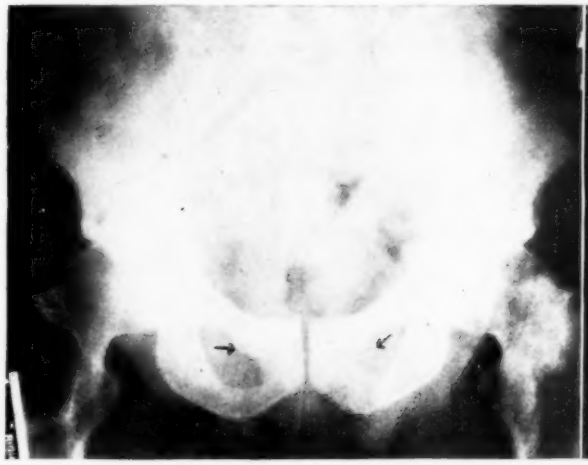

Fig. 8. (Case III.) No osseous metastases found until three and one-half years after they had appeared in the lungs.

Fig. 9. (Case IV.) Pathological fractures, left pelvic rami. There are no metastases on right side of pelvis but head of right femur is involved.

Fig. 10. (Case IV.) Pulmonary metastases.

to metastatic malignancy. There is an unusual picture of metastases arising from the prostate but is more likely metastases coming from a testicular tumor (Lloyd Bryan)." Following his second deep therapy treatment he developed a rectovesical fistula and on Jan. 29, 1930, he had a hemoglobin of 40 per cent and RBC 2,000,000.

In May, 1930, he was confined to his home for ten days with influenza. In August roentgenograms showed an improvement of the lung condition (Fig. 7), but there were three small spots in the pubic bone (Fig. 8), the only metastasis in the osseous system. Another course of deep therapy was started but following the first two treatments he had hemorrhages from the bladder, the second being very severe, so the course has not been finished. There never have been any lung symptoms, although one would expect it from the chest films. *Comment:* Sarcoma or anaplastic carcinoma of the prostate. The metastases to the lungs suggest sarcoma. Deep therapy acts favorably on the lung metastases but following one treatment a rectourethral fistula developed and after others severe vesical hemorrhages.*

Case IV. Pathological fracture of pelvic rami weakened by metastasis from carcinoma of prostate. (Reported through courtesy of Drs. Prince and Lartigau.) E. M., aged fifty-five, married, merchant. On Nov. 25, 1928, while on a picnic, this patient's hat blew off and into a field. He attempted to crawl under a wire fence, stumbled, his legs were thrown into the air and he felt a snapping sensation in his left hip. He rode home, a distance of more than fifty miles, in an automobile, in comparative comfort. His urinary history is unimportant; there has been occasional nocturia, rare frequency, no hesitancy, no dribbling, urinary stream of good force, no history of hematuria or the passage of stones. Rectal examination showed a prostate slightly larger than normal and stony hard in consistency. His present weight of 187 lb. is his maximum for the past ten years, the average being 180 lb. His physical examination was essentially negative except for his pelvic condition. The blood Wassermann test was negative. X-ray pictures (Fig. 9) showed a "fracture of the inferior ramus of the left pubis and the descending ramus of the left ischium. There is a marked irregular sclerosis of the bones of the left half of the pelvis and of the right femur. There is considerable coarse mottling throughout both lung fields (Fig. 10). There is irregular mottling with increase of density in the body of the first lumbar vertebra. Condition is due to metastasis from malignant prostate. There is no evidence of bony changes in radiograph of the skull (Lloyd Bryan)."

This patient was given courses of deep therapy over both the pelvis and the lungs. He remained in bed from four to five months and then returned to his regular duties. He reports at the present time that he is in better physical condition than he has been for years, and so far I have been unable to have him come in for a check-up.

* He continued to perfom his regular duties up to within three weeks of his death which occurred Jan. 24, 1931.

SUMMARY

1. Four cases of cancer of the prostate are reported all of which were beyond the possibility of a cure before they were diagnosed.

2. Backache cases should not be routinely diagnosed sacroiliac slip and "manipulated" for fear of breaking a femur weakened by carcinoma metastases.

3. An unexplained persistent backache in a man past fifty should suggest carcinoma of the prostate.

4. The lung metastasis caused no subjective symptoms; those in the vertebrae manifested themselves as backache, while those in the pelvis and the femur were silent until fractures occurred.

5. The treatment should be conservative, no surgery being done except for symptomatic relief. Deep therapy should be given routinely as bone metastases so treated may cause no subjective symptoms for eleven years, or more.

A NEW ENDOVESICAL INSTRUMENT*

NED SHNAYERSON, M.D.

NEW YORK

WHENEVER one can avoid an open operation it is logical and desirable to do so. To this end I have devised the electrode described here which I have found an extremely useful instrument.

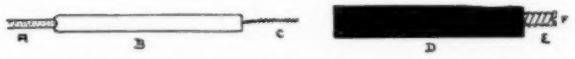

FIG. 1. Female shaft D separated from the male shaft B, showing proximal end of wire C coming through sheath of the electrode A and through male shaft.

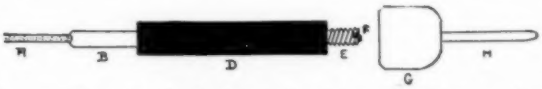

FIG. 2. Female shaft slipped over male shaft and end of wire turned down on threaded post of female shaft at F. Cap G when screwed on to the post E will secure wire to post E.

FIG. 3. Mechanism assembled and ready for use.

It is not the purpose of this paper to decide the indications for the use of this type of electrode, nor does it mean to supplant all open operations in the removal of intravesical tumors, but rather to describe the construction of the instrument and how it is used. Where surgical diathermia is indicated, there are, however, a certain group of selected cases in which this electrode will obviate an open operation.

This electrode is of the loop type and its principle is that of the cutting current of diathermia. The cutting loop electrode, though widely used in surgical diathermia, has never been used in cystoscopic procedure.

The scope of its use will vary from the removal of simple polypi, which is greatly facilitated with this method, to the removal of broader based neoplasms. It has been necessary in the removal of broad based neoplasms by surgical diathermia to either fulgurate the mass bit by bit, or resort to an open operation of the bladder, "looping" out the mass with a loop electrode. By use of this new electrode through a cystoscope, it is now possible to "loop" out an intravesical mass without opening the bladder. This electrode has great variability and will operate through many planes. The loop can be made larger or smaller within the bladder. It can be further manipulated by the drawing up or pushing through of the wire within the sheath of the electrode; advancing or withdrawing the whole electrode; manipulation of the beak of the cystoscope; manipulation of the cystoscope itself; or any combination of any of these movements.

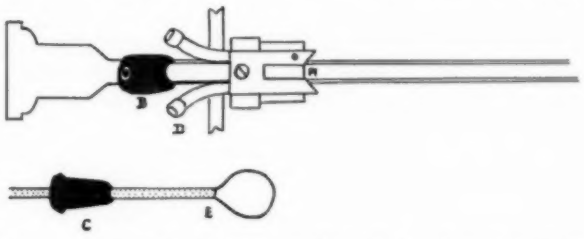

FIG. 4. Upper figure is operating shaft of cystoscope with channels indicated by B-A and D-A. Lower figure shows distal end of electrode with small rubber stopper C on sheath and loop in place.

Bleeding of the cut surface is controlled by the current employed. In simple pedunculated polypi, the ordinary cutting current is used. If there be some bleeding at the base, the loop may be touched to or drawn across this point while a coagulating current is sent through. Where one deals with the larger and more vascular tumors the coagulating current is increased. In this procedure the stroke of the loop is slower, allowing fuller coagulation as the loop passes through the mass. Also, if one wishes to further insure against bleeding, an area of coagulation may be sent into the base before cutting the tumor.

* Submitted for publication September 30, 1930.

This procedure is not for the inexpert or one unfamiliar with the manipulation of the cystoscope and its accessory instruments. With the wide variation, the many combinations of movements through different planes and with a little care, there need be no fear of penetration of the bladder wall, and I believe the surgeon will find this electrode a useful addition to his armamentarium.

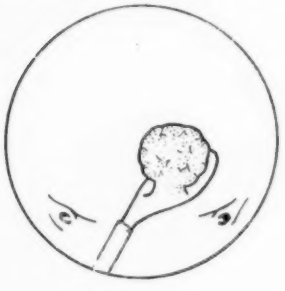

Fig. 5.

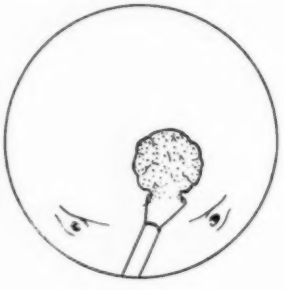

Fig. 6.

Fig. 5. Cystoscopic view of polyp at base of bladder and loop placed over tumor.

Fig. 6. Same as Fig. 5 but showing loop made smaller to fit close to base of pedicle and instrument ready for cutting.

CONSTRUCTION

There are five parts which make up this electrode (see Figs. 1 and 2).

1. A wire C with a looped end.

2. The sheath A made of woven silk as in ordinary electrodes.

3. A male shaft B fixed to the proximal end of the sheath and through which the wire C extends.

4. A female shaft D which slides freely over the male shaft B and having at its proximal end a threaded post E.

5. A cap G which screws onto the post E at the proximal end of the female shaft. This cap has a tip H for connection to the cord leading to the energizing apparatus.

The wire C is inserted at the distal end of the sheath A and passed through it and the shaft B until the base of the loop just touches the distal end of the sheath (Fig. 4 E). The female shaft D then is slipped over this wire and the male shaft (Fig. 2 B). The end of the wire is turned down on the post (E) as in Figure 2 F. When the cap G is screwed onto this post (Fig. 3), the wire is fixed to a unit consisting of the shaft D and the cap G.

Fig. 7. Entire instrument assembled and showing a polyp, which has just been cut away, attached to loop.

Since the wire is fixed to this unit and is entirely free within the rest of the electrode, advancing and retarding the shaft D on the shaft B will cause a corresponding movement to the loop. By retarding the female shaft, the loop is drawn into the sheath A and made smaller. If one wishes to make the loop very broad, the entire electrode is advanced through the cystoscope while the distal arch of the loop rests against the bladder wall. The wire is sufficiently flexible to conform to this pressure and so flatten the loop. The frequent use of this electrode will eventually cause fraying at the end of the sheath A. This is very simply remedied by snipping off the frayed end with a scissors.

The insertion of the electrode is best accomplished with the operating shaft of the cystoscope removed from the cystoscope sheath.

Before inserting the wire into the electrode, a rubber stopper is slipped onto the sheath of the electrode. If the electrode is to be passed through the operating channel of the cystoscope, the ordinary large rubber stopper (Fig. 4 B) or a small rubber stopper reversed (Fig. 4 C) is used. The loop may then be passed through the operating channel at B to emerge at A (Fig. 4). With the electrode well down on the operating shaft the unit may be replaced into the sheath of the cystoscope and the instrument is then ready for use. Should the operator employ a catheterizing cystoscope, the sheath of the electrode

is inserted into the catheterizing channel (Fig. 4 D), with the rubber stopper on the sheath in the ordinary direction, and

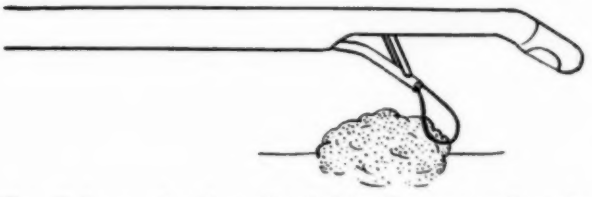

Fig. 8. Loop placed at distal side of tumor and ready to cut off a section.

the wire threaded through the electrode sheath *after* the electrode is in place on the operating shaft of the cystoscope. With the instrument in place, the electrode can be operated through many planes as described earlier in this paper.

Figure 5 shows a cystoscopic view of a pedunculated tumor with the loop of the electrode slipped around the tumor. In Figure 6, the loop has been made smaller to encircle the base. As the cutting current is sent through the electrode, the whole electrode is retarded through the cystoscope and the tumor will be cut away at the base of the pedicle leaving a clean flat surface. Figure 7 shows a photograph of a similar tumor which was located at the upper and right lateral wall of the bladder in an adult male. This was a bleeding polyp and found to be a papillary carcinoma (Grade II). When I removed this polyp, it came away attached to the loop as shown in the photograph.

The method of approach with broader based neoplasms is indicated by Figures 8 and 9. The loop is placed at the distal portion of the tumor (Fig. 8). If the tumor

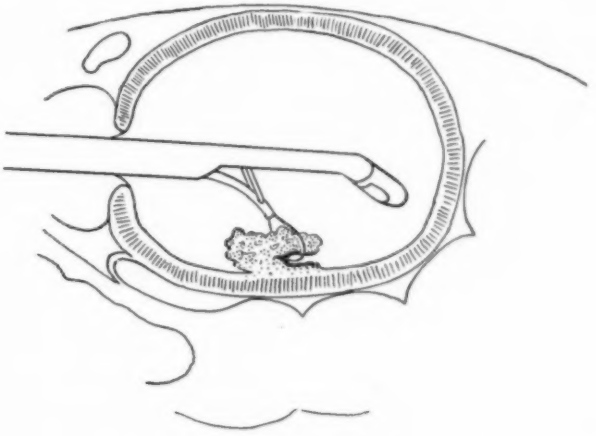

Fig. 9. Loop cutting through tumor.

is not large, a good part of it will be cut through by the sweep of the loop when the beak of the cystoscope is depressed. This motion may be augmented by a tilting of the cystoscope itself. If the tumor is quite large, as in Figure 9, the cystoscope is retarded with the loop depressed as shown in the drawing.

SUMMARY

A new endovesical instrument has been presented with detailed description of its construction and some suggestions as to its use. It is hoped that the surgeon will find it as useful an instrument as the author has found it to be.

CUNEIFORM OSTEOTOMY

A METHOD OF PLANNING DIMENSIONS OF WEDGE TO BE REMOVED*

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PITTSBURGH, PA.

CUNEIFORM osteotomy being an operation of election it is possible and desirable to plan in advance the size and shape of the wedge of bone to be removed. Such advance care is amply rewarded by reduction in the operating time, by the possibility of obtaining better alignment of the two sections of bone and by the truer apposition of the cut bone ends obtained.

By the use of the protractor introduced by the writer in 1921[1] and shown in Figures 1 and 2 it is possible, not only to measure the angular deformity, but to lay out on an *x*-ray film or a tracing of the same the exact dimensions of the wedge of bone to be removed.

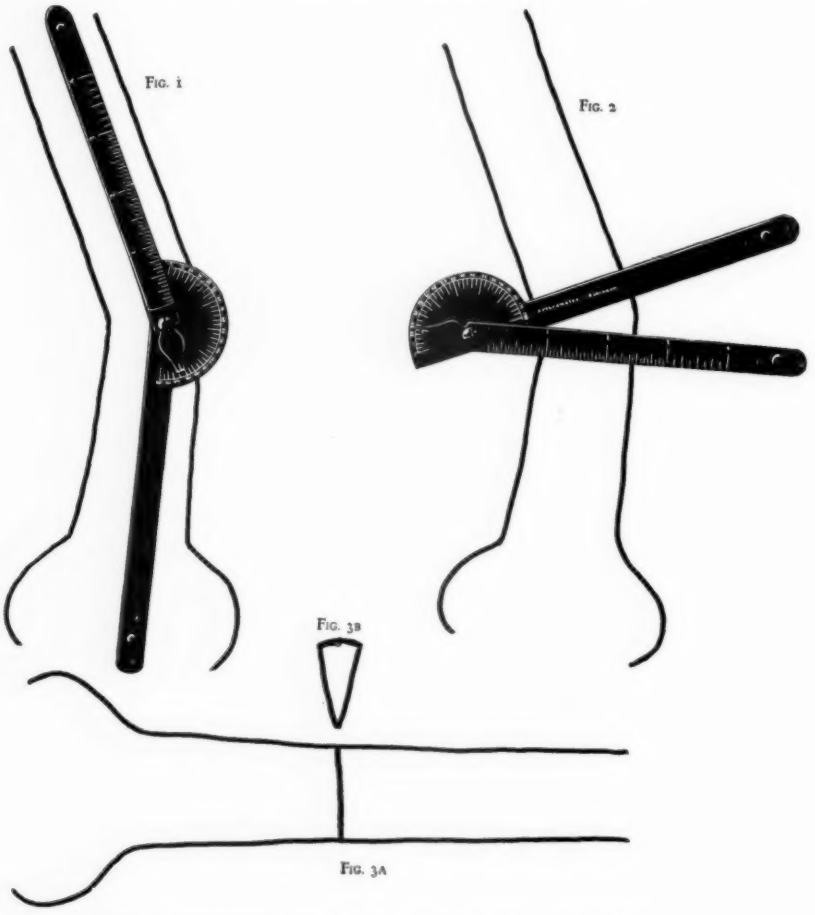

FIG. 1. Protractor placed to show angular deformity.
FIG. 2. Protractor placed to show dimensions of wedge.
FIG. 3 A. Effect on the bone of removal of the above wedge.
FIG. 3 B. The wedge.

Method. The angular deformity is measured by placing the instrument over the *x*-ray film or its tracing in such a manner

[1] Robinson, W. H. Joint range. *J. Orthrop. Surg.*, 3: 41, 1921.

* Submitted for publication August 29, 1930.

that the axis pin coincides with the point of greatest curvature and the two arms coincide with the axis of the respective sections of the shaft of the bone (Fig. 1). The pointer will now point to the figure indicating the actual angulation. As the scale of this instrument is from 0 to 180 the latter figure being equivalent to a straight line, it is necessary to subtract the reading from 180 to obtain the number of degrees of deflection. Adjust the pointer to indicate this number on the scale. Now, without altering the position of the arm, lay the instrument on the film or its tracing with the apex of the open space between the arms at the point of greatest concavity on the concave side of the bone and the dimensions of two sides of the proposed wedge will be indicated by the inner edge of the two arms while the third side will be shown as the convex line of the bone between the arms.

Example. In the illustration the angular deformity is 155° which subtracted from 180° leaves 25° as the actual deflection. Placing the pointer at 25° on the scale and placing the instrument on the *x*-ray film or outline tracing shows the angle of two sides of the wedge between the arms of the instrument and the third side on the convex side of the bone between the two arms. The length of this third side is (on the tracing used) ½ in. (7 cm.).

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*Continued from p. 501.

The American Journal of Surgery

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EDITORIAL

THE GENERAL SURGEON AND SURGICAL PATHOLOGY

THE day has arrived when the general surgeon must of necessity become a student in surgical pathology. Surgical pathology has made marked strides in progress during the past two decades. The general surgeon of today fully realizes this fact and recognizes that if he is to give the best possible in surgery to his patient he must fully understand the microscopical development of the condition for which he operates.

The sounder and more thorough the understanding of the principle of the underlying microscopical development making it necessary to operate the more effective and satisfactory will be the work of the general surgeon. If the general surgeon does the best possible in his field of endeavor in any case he must have this understanding of the development of the condition for which he operates.

The day has also arrived when the public expects an accurate opinion as to the prognosis in surgical conditions. No general surgeon can give a properly outlined prognosis without being able to study microscopically the tissue in question. The microscope should be the third hand of every general surgeon. All tissue removed at the operating table should be sectioned for study by the general surgeon who operates.

For years the general surgeon had acquainted himself with the macroscopical appearance of specimens obtained at the operating table. It has become his custom to carefully study these gross specimens and visualize the comparison of simi-

lar specimens obtained from other like operations.

Now the time has arrived when this general surgeon is no longer content to let his personal study end in the gross findings. Possibly the intensive campaign against malignancy has been responsible for this present feeling among general surgeons. We are bound in the future to be better able to combat much more effectively the various types of malignancy to which the human race is subjected.

Medical schools will in the near future establish schools of instruction in surgical pathology where the general surgeon can go to acquaint himself with this line of endeavor so closely allied to his everyday life.

Joseph Colt Bloodgood of Johns Hopkins University is one of the outstanding figures in the field of surgical pathology. His personal untiring efforts of the past few years coupled with his ability to organize has made it possible for the general surgeon to become a student in surgical pathology.

Especially in dealing with a questionable malignancy every general surgeon should have the portable frozen section table equipment at hand and even while the operation is going on he can personally study under the microscope the tissue he is removing. Thus can the general surgeon more intelligently and with better judgment decide what type of operation and the extent of the same is best for the case in question.

We are making rapid progress in all lines of medical science, yet, none stands out more prominently in this advance than does microscopical study in collaboration with surgery. If we are to meet with better success in the future especially in lowering the present-day mortality due to malignancy our fort lies in every general surgeon's becoming a student of surgical pathology. The study of tissues under the microscope, the early recognition of malignancy microscopically in its very early stages, the complete removal of these cancer cells and the ability to differentiate these tissues at the time of operation are our present hope for lowering the mortality rate from this disease. The general surgeon who becomes a student of surgical pathology is the individual who will be fitted to render such a service to humanity.

G. S. Foster.

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"ROENTGEN RAY"

WILHELM CONRAD ROENTGEN was born on March 27, 1845, in Lennep, a town in the industrial section of Germany.

His father was a manufacturer of cloth. Roentgen's mother was Dutch. Her people were well known in shipping circles.

Wilhelm Roentgen was an only child. Born of cultured parents he acquired a love for the beautiful which held his interest throughout his life.

As a very young boy he lived in Holland with his mother's relatives; later, he moved with his parents to Apeldoorn and attended school in Utrecht. He was commonplace as a student. He was placed in a school for machinists so he could prepare to enter his father's factory. He took the examinations to enter college but failed. A friend informed him he could enter the Zurich Technical High School without the usual credentials. Roentgen entered this school and there Clausius, Professor of Theoretical Physics, and Kundt, the experimental physicist, instilled such an interest for the physical sciences in Roentgen's heart that soon he was devoting all his energies to this subject. On June 22, 1869 he was graduated with the degree of Doctor of Philosophy. He accepted a position as assistant to his teacher, Kundt. Somewhat later Kundt accepted the chair at Wurzburg and Roentgen followed him there. While in Wurzburg he married Bertha Ludwiz. They never had children but adopted a young neice of Mrs. Roentgen's.

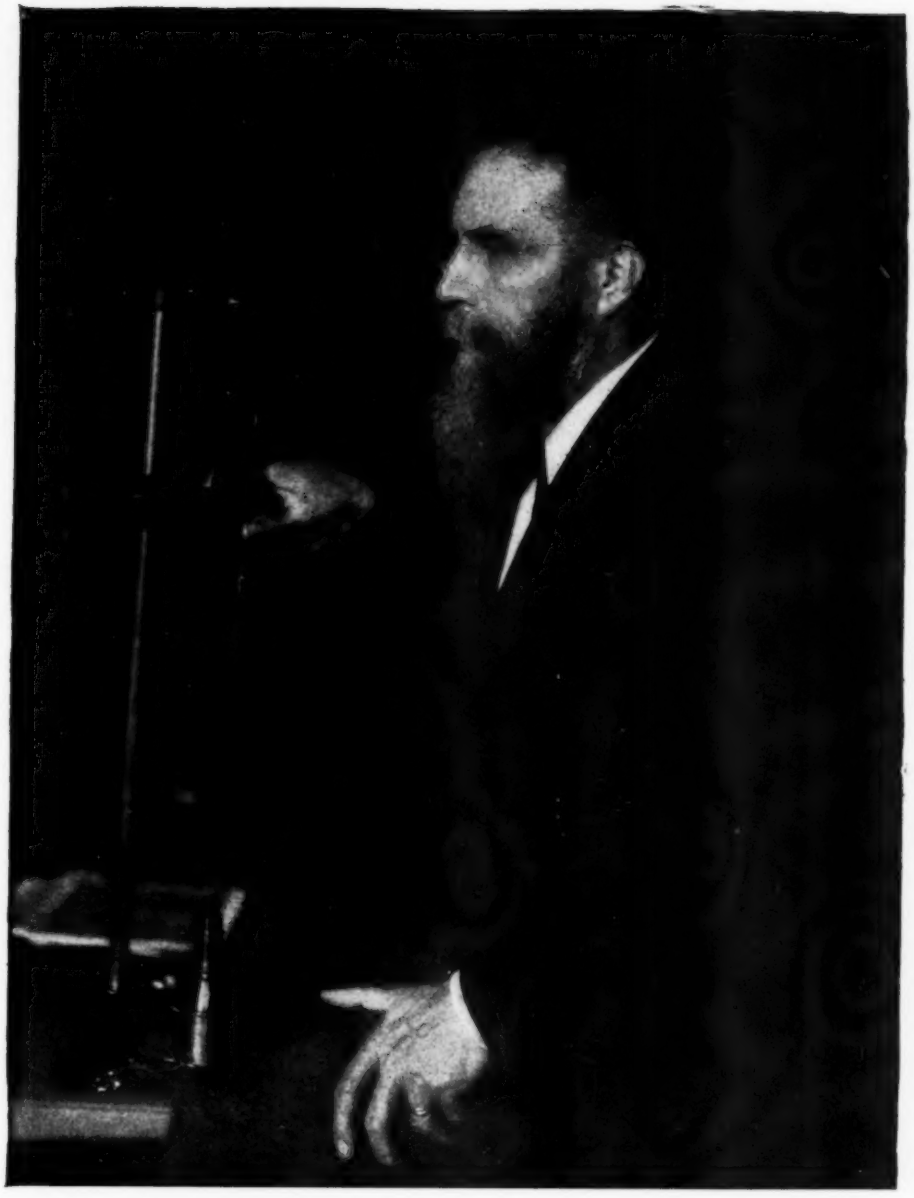
Kundt went to the newly founded university in Strassburg and Roentgen went with him. On March 13, 1874, Roentgen became Privatdozent of Physics. A year later he accepted the chair of physics and mathematics at the Academy of Hohenheim. He was not happy here and a year later returned to work with Kundt as Associate Professor of Theoretical Physics. He and Kundt published some excellent papers which led to the offer which he accepted of the chair of physics at Giessen University. He remained there ten years. He did some of his best work at Giessen and often referred to his days there as the most happy ones of his life. In 1888 Roentgen succeeded the brilliant Kohlrausch at the University of Wurzburg. A few years previously this university had refused to give Roentgen his academic standing. It was while at Wurzburg he made his discovery of the *x*-rays, in November, 1895.

The "discovery" was the result of years of work and the work of many scientists which Roentgen correlated. Roentgen named his discovery the *x*-ray.

His honors were many. Universities vied in their attempts to get him on their staff. He remained at Wurzburg until April, 1900, when he accepted the chair at the University of Munich by special request of the Bavarian government. In 1901 he was awarded the first Nobel prize.

The war broke his spirit. He loved his fatherland. His wife, whom he dearly loved, died on October 31, 1919. Most of his friends were gone. Sad of heart, Roentgen died of a carcinoma on the intestines on February 20, 1923, at the age of seventy-eight years.

T. S. W.



WILHELM KONRAD ROENTGEN

[1845-1923]

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[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

BEACON LIGHTS IN ALABAMA*

L. L. HILL, M.D., LL.D., F.A.C.S.

MONTGOMERY, ALA.

AS Dr. Weir Mitchell said of Benjamin Franklin, he came from Boston but was born in Philadelphia at the age of seventeen; so I say of Marion Sims, he came from South Carolina but was born in Alabama, in 1835, at the age of twenty-two years. Before coming to Montgomery Dr. Sims located at Mt. Meigs, a little village thirteen miles distant. It was a long way from the hovel of the negro slave at Mt. Meigs, Alabama, to the boudoir of the Empress Eugénie in the magnificent palace of St. Cloud where Dr. Sims had professional supervision of the Empress's health. He was especially skilled in plastic surgery, being a mechanical genius, and did successfully all of the capital operations of his day and time including those of the eye. As an operator he was skillful, resourceful, and thoroughly self-possessed, but there was in his work none of the aggressive, dramatic clock surgery of Baron Larrey, who on that frightful field of Borodino, in 1812, amputated 200 limbs in twenty-four hours, and had 7 recoveries out of 11 shoulderjoint disarticulations. This was before the discovery of anesthesia or antisepsis, and it has been said a minute was Baron Larrey's usual time for an amputation and 25 per cent his mortality. Dr. Sims though usually successful had his calamities. Lawson Tait in speaking of "bad luck in surgery" always mentioned Sims' operation on a case of vesicovaginal fistula at the Samaritan Hospital in London and how six days later at the post mortem it was found he had inadvertently closed the ureters, as well as Burdon-Sanderson's discovery on post mortem that Sir Henry Thompson had left in the bladder of Napoleon III an uncrushed stone weighing ¾ oz. In 1845 a woman was thrown from her horse and suffered a retroversion of the uterus and while correcting the displacement Sims discovered the effect of atmospheric pressure in the vagina that led to the invention of Sims' speculum, Sims' position, a special suture of silver wire, a catheter, and the cure of vesicovaginal fistula. This was the "tide in the affairs" of Dr. Sims "that was taken at the flood and led on to fortune." His first three operations, all of which were successful, were performed upon negro women, Anarcha, Lucy, and Betsy. The names of these three colored women will be irrevocably associated with the memory of J. Marion Sims, as will the name of Joseph Meister, the Alsatian boy, be associated with Pasteur, that of Venable with Crawford W. Long, that of Alexis St. Martin with Beaumont,

* Submitted for publication March 14, 1931.

and that of the twenty-five year old man with Lister upon whom, with the aid of his antiseptic system on April 11, 1868, Lister produced artificially a compound fracture into the anklejoint and restored an absolutely useless limb. Born the year Beethoven died, Lister's life was the exemplification of the closing lines of the great composer's immortal ninth and last symphony, "Millions loving I embrace you, to the whole world this kiss I send." Lister, who converted surgery, a near massacre, into a healing art, left us the richest legacy of all the dead. It has been said some things are immortal: the plays of Shakespeare, the marbles of the Greeks, and the music of Wagner, and I will add the speculum of Sims; no one in eighty-five years has been able to make the slightest improvement upon it. In 1861 Dr. Sims demonstrated his method of operating in most of the great cities of the world. How different was the altruistic spirit of Marion Sims from that of John Abernathy who, until Thomas Wakley appealed to the courts, lectured to his students in the dark to prevent his methods from being given by the London *Lancet* to the profession, or from that of Johannes Jacobus Rau, of Amsterdam, who dissected the bodies of the patients that Frère Jacques had lost after his lithotomies and discovered that the improved operation consisted in dividing the prostate and neck of the bladder. Rau kept this a profound secret and taught his students that he still cut through the posterior wall of the bladder, a much more dangerous operation. Albinus, a pupil of Rau who had been thus deceived, taught Cheselden in England to cut through the posterior wall but Cheselden soon discarded this as unsatisfactory and devised an operation upon correct anatomical lines which he usually performed in a minute. Sir D'Arcy Power says Cheselden's operation was popular in Europe until 1885 when lithotrity came in vogue. It might be of interest to recall it was Cheselden's operation that Dr. Physick was taught by John Hunter and which he performed upon our great Chief Justice John Marshall, removing a thousand stones from his bladder. Of course we all know that the Liberty Bell was cracked, in 1835, while tolling for the great Chief Justice, but that was four years after Dr. Physick's operation. Sims was a pioneer in gall-bladder surgery and gave us the name of cholecystotomy in 1878. There was in the many-sided make-up of Dr. Sims "the pert and nimble spirit of mirth." When he lived in Montgomery one of his children born on Christmas day was promptly named "Merry Christmas." Dr. Sims removed to New York in 1853 and founded the Woman's Hospital in 1855. He died in New York City in 1883. There is a statue of him in Bryant Park, New York, and a memorial tablet in Montgomery, Alabama, erected to his memory at 21 S. Perry Street where his hospital was located and where he did the first successful operation for vesico-vaginal fistula. Montgomery, Ala., claims to be the birthplace of gynecology with J. Marion Sims as the parent.

Though Alabama claims Dr. Josiah Clark Nott, just as J. Marion Sims, he came from South Carolina, and was graduated from the medical department of the University of Pennsylvania, while Sims was graduated at Jefferson Medical College. In 1844, in the *New Orleans Medical Journal* Nott described the condition and Sir James Y. Simpson, in 1861, gave the nomenclature, coccygodynia. Samuel D. Gross says that as early as 1832 Dr. Nott first performed a coccygectomy on account of "severe and intractable neuralgia." In 1848, in the *New Orleans Medical Journal* Dr. Nott suggested the "mosquito theory" with reference to the transmission of yellow fever, antedating Carlos Finlay by thirty-three years. In 1859, Dr. Nott founded the Medical College of Alabama and lectured on surgery. He died in Mobile in 1873.

John A. Wyeth was born in Marshall County, Ala., in 1845. He married Dr. J. Marion Sims' daughter, Florence Nightin-

gale, in 1886, and died in New York in 1924. Dr. Wyeth was the founder of the first post-graduate medical school in the United States. In 1890 he demonstrated his bloodless amputations of the shoulder and hip-joints, in 1903 the treatment of vascular tumors by injection of hot water, and in 1909 he was the first to cure sarcoma by streptococcus infections. Dr. Wyeth's "Text Book on Surgery" passed through four editions and greatly enhanced the author's reputation. He was offered the chair of surgery in Tulane University upon the resignation of Dr. T. G. Richardson, the favorite private pupil of Dr. S. D. Gross in Louisville, Ky. Dr. Richardson was celebrated as an anatomist and in 1841 without anesthesia successfully amputated both legs at the hip-joint. Dr. Wyeth declined the offer saying, "It was a great temptation to go back home but my heart was in the work of building up the Polyclinic as a great post-graduate medical school." In 1914 appeared his charming autobiography, "With Sabre and Scalpel." Dr. Wyeth was personally the most popular doctor in the United States and was honored with every great elective office within the gift of the medical profession. There is a statue of him in his operating overalls on the Capitol grounds at Montgomery, Ala. The Civil War ended with Dr. Wyeth at Appomattox. He was loyal to the Union but he could not forget that he had once followed the stars and bars. He wrote the best biography of Lieutenant-General N. B. Forest, a negro trader who without education or military training entered the Confederate Army as a private, became a Lieutenant-General and was pronounced by Jefferson Davis as the genius of the Civil War. When William Dean Howells eulogized Mark Twain and called him the most desouthernized Southerner he ever knew Dr. Wyeth answered that it was true, that when a lieutenant in the Confederate Army Mark Twain deserted and wrote an impudent letter to his commanding officer stating as his reason that his health had been broken down due to too much retreating.

Dr. Henry S. Levert, of Mobile, Ala., by experiments on dogs showed the innocuous character of lead, gold, silver, and platinum wire for tying arteries. In 1866 his nephew, Dr. C. H. Mastin, of Mobile, who was his assistant, successfully tied the external iliac artery with silver wire.

Dr. Seneca D. Powell was born in Wilcox County, Ala., in 1847. He was a Confederate soldier, in 1869 was graduated from the University of Virginia, and in 1870 from the University of New York, and became chief assistant of the celebrated New York surgeon, James L. Little. Dr. Powell was the discoverer of the fact that pure alcohol instantly neutralizes the caustic effect of carbolic acid. He told his nurse to hand him a 5 per cent solution of carbolic acid with which to wash his hands, and instead she gave him the pure acid; not knowing what else to do he ran his hands down in a pan of alcohol with perfect relief. Starting from this Dr. Powell introduced the carbolic acid treatment of leg ulcers with fine results.

Sir William Osler Boswellized Dr. John Y. Bassett, of Huntsville, Ala., An Alabama Student.

Alabama has furnished four presidents of the American Medical Association, W. O. Baldwin, J. Marion Sims, John Allan Wyeth, and W. C. Gorgas. In 1865 Samuel D. Gross came to Montgomery, Ala., to perform lithotomy and received $2000.00, which he said was the largest fee he had ever gotten. While in Montgomery he met Dr. W. O. Baldwin, a very able man with a charming personality. Dr. Baldwin was a successful physician, first to discover quinine amblyopia, banker, financier, and an intimate friend of J. Marion Sims and William L. Yancey, the South's greatest orator. It occurred to Gross, who was then in "the noon and zenith of his career and in the flush and glory of success," that to bring about good feeling in the American Medical Association a Southern man ought to be elected president

at the next meeting, and Gross selected Baldwin. Dr. Baldwin's inaugural address was a classic and his administration justified Dr. Gross's selection.

Alabama Medical Association was organized under its present system in 1868. Alabama is the only state in which the Medical Association is a part and parcel of the State government. The Governor of the State is the Chairman of the State Board of Health. Semi-annually the State Board of Censors meets to examine candidates for the practice of medicine in Alabama. These examinations are very rigid. The Health Department was perfected by Dr. Jerome Cochran, a man of great learning and eminently adapted to organizations. A good many foreign doctors come annually to study our system.

The Medical College of Alabama was founded by Dr. J. C. Nott, in 1859, at Mobile, Ala. Nott went to Europe the following year and spent $50,000.00 purchasing specimens for the museum. Dr. Nicholas Senn said that some of the preparations are "worth their weight in gold and cannot be duplicated." In 1907 the college became the School of Medicine of the University of Alabama, and in 1920 was moved to Tuscaloosa and clinical teaching discontinued.

The Alabama Surgical and Gynecological Association was founded by Drs. John and Elias Davis, of Birmingham, Ala., and held its first meeting in that city, in 1888, with Dr. W. D. Haggard, Sr., of Nashville, as President and Dr. Elias Davis as Secretary. The name was subsequently changed to Southern Surgical Association. A few years ago when the association met in Birmingham it erected in Wilson Park a statue in memory of Dr. Elias Davis.

On May 17 the profession of Alabama lost one of its most popular and distinguished members, Dr. John Davis, of Birmingham, and it was a sad day for me as, to use an expression of Lord Balfour, the roots of our friendship went down into the same past for more than fifty years. Dr. Davis was terribly mangled in an automobile accident and with more than a hero's courage, with more than a martyr's fortitude he bore his suffering, and met the inevitable end that awaits each and all.

Green be the turf above thee
Friend of my better days
None knew thee but to love thee
Nor named thee but to praise.

BOOK REVIEWS

THE PHYSICIAN OF THE DANCE OF DEATH. By Aldred S. Warthin, N. Y., Paul B. Hoeber, Inc., 1931.

Fortune is the physician with a hobby, and particularly fortunate is he whose avocation leads him ever onward, away from the narrowing influence of his specialty and into fields of deep learning and rich culture. As Osler once said, medicine is a jealous and exacting mistress, one who usually reserves her favors for those who woo her constantly, and her alone. Perhaps it is for this reason that there have been so few physicians of the stamp of Osler and Holmes and Mitchell, who could become distinguished as men of letters without at the same time dimming their reputations as men of science; and it is for this reason that we welcome with particular pleasure the advent of the new book which now shows that a great pathologist is, at the same time, a thoughtful philosopher and a learned historian.

In Doctor Warthin's foreward he tells of the young medical student who, in 1893, while passing through Nuremberg on his way to Vienna, stopped before a shop window to admire a fine print of Albrecht Dürer's "Ritter, Tod und Teufel." So deep was the impression made upon the youth by this picture that it was purchased, and with it there came an inspiration and an interest that have remained and grown through all the succeeding years. Year by year Warthin has added to his collection examples of every known representation of death in art, and of every known book on the subject, and in spare time he has traced through this material man's ever changing concept of death and of what lies beyond.

The earliest pictures, dating back to 1424, represent death in its most fearsome aspects. This is as one would expect when one takes into account the uncertainty of life in those days. War, pestilence, and injustice were always abroad in the land, and to anyone, horrible death was likely to come at any moment. With churchmen depicting a hereafter in which there was little to look forward to beside unending torment and misery, one can easily see why the men and women of that day pictured death as a hideous fiend: a bony cadaver who, appearing early and uninvited, dragged his young and unwilling victim down into the pit.

It was only after several centuries that this fear of premature death began to disappear from the artists' pictures, and in its place came the idea of death coming sometimes as a friend of the aged, a friend bringing release from weariness and pain.

Doctor Warthin's study contains much of interest, not only to the historian, the artist, and the man of letters, but to the physician, because it throws so much light on the development of medical practice and prestige. The pictures show first the popular contempt for the quack with the ever present urinal held up to the light; they show his dress, and in many ways they indicate his low social position. Gradually, as time progressed, the urinal disappeared, the physician became better trained and more dignified, and his social position accordingly improved.

As time went on and life became less uncertain, the artists became less and less interested in depicting the horrors of death and more and more concerned with cataloging its causes. Finally, there came the great war, and with it a new type of picture showing the horrors of death in the trenches.

Today, the intense fear of death is largely gone; modern man has learned to face his departure from this life with resignation, with bravery, or with cynical indifference. To a large extent he has lost his faith in a hereafter; he refuses to speculate very much about it or to prepare for eventualities, and often he pays little attention to the proffers of help from those who would prepare the way before him in the promised land. Under these circumstances the Dance of Death motif now awaits new treatment at the hands of present day artists.

Typographically, the book has all of the attractiveness which one has come to associate with the name of Hoeber. It is lavishly illustrated and there is an excellent bibliography. The book will doubtless be read by every earnest student of the history of medicine, and by many of the modern group of historians who are interested less in the chronicles of kings and battles and more in the thoughts and lives and customs of the common people.

Selections from the Papers and Speeches of John Chalmers DaCosta, M.D., LL.D., Samuel D. Gross Professor of Surgery, Jefferson Medical College, Phila. 440 pages. Phila., Saunders, 1931.

The feeling of the reviewer in picking up this book is "how did he do it?" Here is one of the busiest and most famous surgeons in America producing a book of over 400 pages with the following table of contents.

Medical Paris During the Reign of Louis Philippe
The Trials and Triumphs of the Surgeon
Address on the Occasion of the Graduation Exercises at the Naval Medical School in Washington on March 30, 1907
Dickens's Doctors
Baron Larrey: A Sketch
The Old Blockley Hospital: Its Characters and Characteristics
Then and Now
The Old Jefferson Hospital
Character Sketch of Professor Samuel W. Gross, M.D., LL.D.
The Surgeon, The Patient, and The Clinical Diagnosis
Behind the Office Doors. Surgical Oration Before the Ohio State Medical Association
Crawford W. Long
The Samuel D. Gross Address for 1914–15
William Williams Keen: A Sketch
The Foundation and the Founder of Jefferson Medical College
The Last Surgical Clinic in the Old Amphitheater of the Jefferson Medical College Hospital, Held Before the Junior and Senior Classes, May 10, 1922, By Professor John Chalmers DaCosta
Facts Concerning the Old Operating Table
Certain Tendencies in Medicine
Address at the Opening of the Nurses' College of the Allentown Hospital December 23, 1915
The Personal Side of Pepys
Suicide

Everyone of these articles is full of meat and worth reading, not only for pleasure but for what is to be learned therefrom.

Quoting at random a few short excerpts will perhaps whet the appetite for more of this mental stimuli: "it is interesting to know what men do who give up medicine . . . some go to the devil and some go to Congress," and then there is a whole page of the most interesting comments on this, particularly devoted to interesting answers to these most pertinent questions.

How many are aware that Keats gave up being a dresser in Guy's Hospital and wrote the Ode on a Grecian Urn? The entire chapter on The Trials and Triumphs of the Surgeon should be read and reread by every surgeon interested in his calling. Then in the chapter Behind the Office Doors, we find such phrases as "I am sitting writing among my medical books. One must have at hand books of literature, books for study, books for diverting reading, and books for immediate reference. Unless things are looked up at once, they are seldom looked up at all." Enough of this—we would be tempted to reprint page after page, but must curb our enthusiasm and suggest that you add this book to your library and read every word of it.

Surgery, Its Principles and Practice, for Students and Practitioners. By Astley Paston Cooper Ashhurst, A.B., M.D., F.A.C.S. Ed. 4, thoroughly revised, 1189 pp., Phila., Lea & Febiger, 1931.

The fourth edition of Ashhurst's "Surgery" is before us, and as in the previous editions, the ground is fully covered and the work is entirely up-to-date.

Of course, no volume of 1200 pages covering the entire subject of surgery, will satisfy any given individual in its entirety. If it did, there would be no excuse for the numerous volumes that are published on this subject with, what seems to the reviewer, appalling frequency.

However, it may truly be said that for a student's textbook and for a quick reference book, Ashhurst leaves little to be desired.

Traumatotherapy (Treatment of the Injured). By John J. Moorhead, B.Sc., M.D., F.A.C.S., (D.S.M.). Ed. 1, 574 pp. Phila., Saunders, 1931.

Dr. Moorhead's new work on "Traumatotherapy" (Treatment of the Injured) covers the ground indicated in the title. The coining of the word "traumatotherapy" and of so many other new words, at the present time, is to be decried.

In less than 600 pages, with 625 illustrations, the author has succeeded in giving the most

important points on the technique of treatment of injuries.

The author states in his Preface that "There is no type of surgery to-day more universal than accident surgery, and in reality we are just beginning to realize that it is a specialty in itself." Why surgical conditions, due to injuries, should be considered from a different aspect from other surgical conditions, is not made clear. It is felt that every general surgeon should be posted on the treatment of injuries as well as on the diagnosis and treatment of other conditions.

The book will be found a handy work of reference.

Obstetrics, a Textbook for the Use of Students and Practitioners. By J. Whitridge Williams. Ed. 6, 1125 pages. N. Y., D. Appleton & Co., 1930.

Through some inexplainable error a review was published in our April issue of the fifth edition of Williams' "Obstetrics." This is one of those errors that *will* occur. We intended to review the splendid new sixth edition of this work which has been entirely reset and entirely rewritten.

This book is particularly strong in the matter of Pathology. There are over 40 new cuts and many of the old pictures have been replaced by new and better ones.

We know of no better book for the student, and it is a splendid work of quick reference for the practicing obstetrician.

Diseases of the Tongue. By Walter G. Spencer, M.S., F.R.C.S., and Stanford Cade, F.R.C.S. Ed. 3, 39 col. illus., 546 pp., Phila., P. Blakiston's Son & Co., Inc., 1931.

This is the third edition of the famous Butlin's "Diseases of the Tongue." It was first published in 1885, translated into German and French, reprinted in 1890, revised by Butlin and Spencer in 1900.

While this book is an entirely new work, the author states very frankly in the preface that "no better foundation for the work could be found than the work of Henry Butlin, who prophesied twenty-five years ago the possibilities of the future, and whose clinical accuracy and surgical skill are still vivid in the memory of those who knew him."

Radium therapy is taken up in detail and, all in all, the book may be looked upon as the most up-to-date monograph at present available on diseases of the tongue.

The Diagnosis and Treatment of Brain Tumors. By Ernest Sachs, A.B., M.D. 224 illus., 381 pages, St. Louis, C. V. Mosby Co., 1931.

The number of brain tumors that the average surgeon is apt to see in the course of his active practice may be very few, but there is no question that he should be able to make a diagnosis, and, for this purpose, if for no other, this book will be a valuable addition to the library of any surgeon. It is splendidly illustrated and complete without being verbose. The book is a credit to both the author and the publishers.

Der Kunstliche Pneumothorax. By Dr. Hanns Alexander. 42 pp., Berlin, Julius Springer, 1931.

In a pamphlet of 42 pages, based on a lecture delivered at the Sauerbruch Clinic in Berlin, the author discusses the present status of the artificial pneumothorax. The work is based, particularly, on the author's article on the same subject in Sauerbruch's "Chirurgie der Brustorgane."

There is no bibliography and no index but there is a very complete table of contents. There are 45 splendid illustrations.

Diagnostic Methods and Interpretations in Internal Medicine. By Samuel A. Loewenberg, M.D., F.A.C.P. Ed. 2, revised, 1032 pp., Phila., F. A. Davis Co., 1931.

This book is published on transparent paper which makes very difficult reading.

The scope of the book is amply described in its title.

The young physician will find this book a very practical one to have on hand for quick reference. Much advice is given in interpretation that should prove invaluable to the beginner. There are over 500 illustrations and an index of 50 pages.

Crippled Children. By Earl D. McBride, B.S., M.D., F.A.C.S. 280 pp., St. Louis, C. V. Mosby Co., 1931.

This volume, intended primarily for the

instruction of orthopedic technicians, nurses, and social workers, is nevertheless an important contribution to medical literature. Its phraseology is that which a semi-professional person is presumed to be able to understand; its content is such that the general practitioner of medicine would find helpful in the diagnosis and management of this class of cases.

The book abounds in technique, a matter which is notoriously variable with regard to habitat, tradition, and experience. The technique is on the whole sound, and admirably serves its purpose in the instruction of those to whose service it is dedicated.

Since the note of prevention is so frequently stressed in these pages, an exception to the teaching contained in the volume might be here singled out for special mention. Congenital dislocation of the hip is still considered as existing in the Lorenz era. It is now known that a reconstitution of the joint to normal is possible only at ages less than half the author's eight to nine year limits.

THE DIET BOOK, FOR DOCTOR, PATIENT AND HOUSEWIFE. By Marguerite Requa Rea. 188 pp., London, Humphrey Milford, 1931.

This book on diets has a splendid array of recipes, which, under the proper guidance of the attending physician, will be found invaluable by the nurse or attendant of the patient.

Published in London, the book is, of course, more suitable for Great Britain than for America. Little fault, however, will be found with the various diets, many of which are in accord with American standards and, all in all, the book will be found an interesting one for the physician to have on hand when making his dietary recommendations.

A HANDBOOK FOR SENIOR NURSES AND MIDWIVES. By J. K. Watson. Ed. 2, N. Y., Oxford Univ. Press, 1931.

This book of 676 pages, in its second edition, is one of those carefully done things that have the appearance of authority on every page. In this country it will prove valuable to those in the nursing profession. It covers a wide range of subjects. Part One deals with medical problems: cancer, blood and health, the ductless glands, constipation, smallpox, even intracranial tumors; Part Two with surgical conditions; Part Three treats of Children, with chapters on Infant feeding, adenoids, convulsions, tuberculosis, pneumonia (this gives an idea of this section of the book). Part Four handles Obstetrical Conditions and is well written and should be read by every trained nurse. The book ends with a section covering Gynecological findings: Menstruation and its abnormalities, Fibroid tumors of the uterus, Cancer of the uterus, and The Commoner Affections of the uterus other than fibroid and malignant tumors.

There is an index.

THE SCIENCE AND PRACTICE OF SURGERY. By W. H. C. Romanis, M.A., M.B., M.CH., Cantab., F.R.C.S. (Eng.), F.R.S. (Edin.), and Philip H. Mitchiner, M.D., M.S. (Lond.), F.R.C.S. (Eng.). Ed. 3, 772 pp., N. Y., Wm. Wood & Co., 1930.

This is the fourth Practice of Surgery that has passed through the reviewers hands within the past few weeks. It is unfortunate that new editions and new books on similar subjects so often appear about the same time. How much more desirable it would be if they could be published say, a year apart, each one thereby being able to record any slight advances during the previous year! However, while this idea would appeal to the reader of books, it would probably not make a hit with the authors and publishers of the individual volumes.

As the authors state in their preface: "The call for a third edition within two years of the appearance of the second edition testifies to the utility of this work to the practitioner and student of surgery." This is quite true, and is ample justification for the issuance of these volumes, which may be accepted as presenting, particularly, the English point of view at the present moment.

DAS POLLERSCHE VERFAHREN ZUM ABFORMEN, AN LEBENDEN UND TOTEN SOWIE AN GEGENSTANDEN. By Dr. Med. Alphons Poller. 210 pp., Berlin, Urban and Schwarzenberg, 1931.

To those interested in making casts, Dr. Alphons Poller's book "Das Pollersche Verfahren Zum Abformen" will be of inestimable interest and value. The technique is explained with typical German thoroughness and the illustrations are well chosen.

PRACTICAL ANAESTHETICS, FOR THE STUDENT AND GENERAL PRACTITIONER. By Charles F. Hadfield, M.B.E., M.A., M.D. Camb. Ed. 2, 336 pp., New York, Wm. Wood & Co., 1931.

According to the author "this book is intended for the medical or dental student or practitioner who, although desirous of becoming an anaesthetist capable of dealing satisfactorily with any case that he may meet, does not wish to employ more expensive or complex apparatus than is necessary for his requirements." The intention of the author (the desirability of which may be questioned), has been achieved in this volume.

CLINICAL ELECTROCARDIOGRAPHY. By Sir Thomas Lewis, M.D., F.R.S., D.SC., LL.D., F.R.C.P., C.B.E., Ed. 5, 120 pp., London, Shaw & Sons, Ltd., 1931.

The fifth edition of "Clinical Electrocardiography" presents the subject concisely, yet completely, as we have come to expect in the case of every book from the pen of Sir Thomas Lewis. Since the publication of the first edition of this book, a number of splendid American publications on the subject have appeared which are probably better adapted to the needs of general practitioners and students in this country than is this book. Those specializing in heart diseases will always gain knowledge from the writings of Sir Thomas Lewis.

HEMORRHOIDS, THE INJECTION TREATMENT AND PRURITUS ANI. By Lawrence Goldbacker, M.D. Ed. 2, revised. 199 pp., Phila., F. A. Davis Co., 1931.

The second edition, called for within one year, would indicate a demand for this book though it would seem that the subject is amply covered in chapters on the subject in textbooks on surgery and proctology.

BOOKS RECEIVED

All books received by THE AMERICAN JOURNAL OF SURGERY are listed in this column as soon as possible after their receipt and this must be considered as adequate acknowledgment. Books that the Editor considers of special interest to our readers will be reviewed in a later issue.

ABDOMINAL PAIN. By John Morley. N. Y., Wm. Wood & Co., 1931.

ANATOMY AND PHYSIOLOGY OF CAPILLARIES. By August Krogh. New Haven, Yale Univ. Press, 1930.

AN INTRODUCTION TO PHARMACOLOGY AND THERAPEUTICS. By J. A. Gunn. N. Y., Oxford Univ. Press, 1931.

AUSSEREN ABDOMINAL-HERNIEN (DIE). By Erich Bumn. Berlin, Urban & Schwarzenberg, 1931.

BAKTERIOLOGIE DER WURMFORTSATZENTUNG UND DER APPENDIKULAREN PERITONITIS (DIE). By W. Lohr and L. Rassfeld. Leipzig, Georg Thieme, 1931.

BEITRAGE ZUR GERICHTLICHEN MEDIZIN. By Albin Habarda. Wien, Franz Deuticke, 1930.

CHININ IN DER ALLGEMEINPRAXIS. By Fritz Johannessohn. Amsterdam. Bureau Tot Bevordering Van Het Kinine-Gebruik, 1930.

CHIRURGIE (DIE). By M. Kirschner and O. Nordmann. Berlin, Urban & Schwarzenberg, 1930.

CHIRURGIA DEL DOLORE. By Ignazio Scalone. Milano, Ulrico Hoepli, 1931.

COAL MINERS' NYSTAGMUS. By G. F. Haycraft, N. Y., Oxford Univ. Press, 1931.

COLLAPSOTHERAPIE DE LA TUBERCULOSE PULMONAIRE PNEUMOTHORAX ARTIFICIEL (LA). By Michel Leon Kindberg. Paris, Masson et Cie, 1931.

DIABETES. By Orlando H. Petty. Phila., F. A. Davis Co., 1931.

DISCOVERING OURSELVES. By Edward A. Strecker and Kenneth E. Appel. N. Y., Macmillan Co., 1931.

DISEASES OF THE TONGUE. By W. G. Spencer and S. Cade. Phila., P. Blakiston's Son & Co., Inc., 1931.

DOCTORS' WIVES. By Henry and Sylvia Lieferant. Boston, Little, Brown & Co., 1930.

EARLY THEORIES OF SEXUAL GENERATION. By F. J. Cole. N. Y., Oxford Univ. Press, 1930.

ETUDES NEUROLOGIQUES. By Georges Guillain and Th. Alajouanine. Paris, Masson et Cie, 1930.

FRACTURES AND THEIR COMPLICATIONS. By George Ewart Wilson. N. Y., Macmillan Co., 1931.

FRANKFURTER ZEITSCHRIFT FUR PATHOLOGIE. By Bernhard Fischer-Wasels. Munchen, J. F. Bergmann, 1930.

HALSTED, WILLIAM STEWART, SURGEON. By W. G. MacCallum. Baltimore, Johns Hopkins Press, 1930.

INTERNATIONAL MEDICAL ANNUAL. Edited by Carey F. Coombs and A. Rendle Short. N. Y., Wm. Wood & Co., 1931.

LETTERS OF DR. BETTERMAN. By Charles Elton Blanchard. Youngstown, Medical Success Press, 1931.

MODERN METHODS OF TREATMENT. By Logan Clendening. St. Louis, C. V. Mosby Co., 1931.

Operative Surgery. By Martin Kirschner. Phila., J. B. Lippincott Co., 1931.

Phi Rho Sigma Fraternity & University of Michigan. By Jonathan and Donaldson Forman and Samuel Wright. Columbus, 1930.

Physical Basis of Personality. By Charles R. Stockard. N. Y., W. W. Norton & Co., Inc., 1931.

Physiology. By John F. Fulton. N. Y., Paul B. Hoeber, Inc., 1931.

Practical X-ray Treatment. By Arthur W. Erskine. St. Paul, Bruce Publishing Co., 1931.

Primary Syphilis in the Female. By Thomas A. Davies. N. Y., Oxford Univ. Press, 1931.

Proceedings of the Royal Society of Medicine. By Hugh Thursfield and J. Swift Joly. London, Longman's Green & Co., Ltd., 1930.

Progressive Medicine. Edited by Hobart A. Hare and L. F. Appleman. Vols. III and IV, 1930; Vols. I and II, 1931. Phila., Lea & Febiger.

Radiologische Praktika. Vol. XVII. Rontgendiagnostik der Gallenblase. By F. Eisler and G. Kopstein. Leipzig, Georg Thieme, 1931.

Recent Advances in Radiology. By Peter Kerley. Phila., P. Blakiston's Son & Co., Inc., 1931.

Roentgenotherapie (La). By Iser Solomon. Paris, L'Expansion Scientifique, 1930.

Strategy in Handling People. By Ewing T. Webb and John J. B. Morgan. Chicago, Boulton, Pierce & Co., 1931.

Surgical Clinics of North America. February, 1931. Phila., W. B. Saunders & Co., 1931.

Surgical Emergencies in Practice. By W. H. C. Romanis and Philip N. Mitchiner. N. Y., Wm. Wood & Co., 1931.

Surgical Nursing. By Hugh Cabot. Phila., W. B. Saunders Co., 1931.

Surgical Pathology of the Diseases of Bones. By Arthur E. Hertzler. Halstead, Kansas, 1930.

Textbook of Physical Therapy. By William Benham Snow. N. Y., Scientific Authors Publishing Co., 1931.

Traitement Medico-chirurgical de L'Occlusion Intestinale Aigue et Subaigue (Le). By Pierre Moiroud. Paris, Masson et Cie, 1931.

Treatment of Injury by the General Practitioner. By Clay R. Murray. N. Y., Harper & Bros., 1931.

Wunderheilungen von Epidauros (Die). By Rudolf Herzog. Leipzig. Dieterich'sche Verlagsbuchhandlung, 1931.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

BY

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

Chapter VIII

ABDOMINAL DISTENTION AND "GAS PAINS"

1. Etiology of Distention and "Gas Pains"

A. General Considerations: Postoperative distention and "gas pains" are closely allied conditions. Abdominal distention represents the ostensible evidence of underlying intestinal distention which, in turn, results from ballooning of the wall of the gut by gas contained within its lumen. Moreover, as the intestine lies within a cavity, or potential cavity, i.e., the peritoneal cavity, the pressure within which is positive, ballooning of the wall of the intestine always indicates positive pressure of gas within its lumen.

Simple distention probably rarely, if ever, gives rise to a sensation acute enough to be dignified by the term "pain," though discomfort may be considerable. Acute pain invariably results, however, when ineffective peristalsis occurs in intestines, the seat of distention. The pain caused under these circumstances is "crampy" or "colicky" in nature, and depends upon the same mechanism of production as the pain of appendicitis, or of gall-bladder colic, i.e., it represents the ineffective attempt of a hollow viscus to empty itself of its contents against pressure. Such pain is recurrent rather than constant; it undergoes exacerbations with every contraction and remissions with every relaxation of the intestinal musculature. The character of the sensations induced and the fact that the fundamental pathology consists of an accumulation of gas within the lumen of the intestines has given rise to the descriptive term "gas pains."

Abdominal operations are almost invariably followed by some degree of distention and "gas pains"; other operations

are occasionally but rarely thus complicated. Usually "gas pains" are mild, but sometimes become severe enough to cause considerable concern. Distention probably occurs most frequently and typically after operations on the biliary tract, less frequently after operations in the pelvis, and still less frequently following operations on the gastrointestinal tract. Distention is rare following operations for inguinal hernia.

It is a matter of common experience that "gas pains" do not ordinarily become established for at least twenty-four hours, usually from thirty-six to forty-eight hours, following operations. This "latent period" is dependent upon a number of factors which combine to depress intestinal tone and peristaltic activity in the early part of the postoperative period.

B. The Rôle of "Physiological" Operative Ileus: As every attendant at abdominal operations soon comes to appreciate, the opening of the peritoneal cavity *per se* in ordinary cases results in almost immediate cessation of intestinal movements; a functional or paralytic ileus is thereby produced. This statement is qualified by the phrase, "in ordinary cases," because as those who have had much experience with splanchnic or moderately high spinal analgesia will readily appreciate, paralysis of the splanchnic nerves tends to obviate this paralytic effect, so that peristalsis may not be completely abolished under such anesthesia. Intestines undergoing operative paralytic ileus under ordinary anesthetics do not soon regain their functional activity, even after the abdomen has been closed.

C. The Rôle of Intra-Abdominal Trauma: The effect of mechanical manipulations is also to interfere with intestinal motility. This factor has been emphasized to a considerable extent in the past, and justly so. Protracted intestinal inertia much more frequently follows extensive intra-abdominal manipulations, especially when roughly or inexpertly performed, than occur under the opposite conditions. Cannon and Murphy[1,2] many years ago, showed that trauma is capable of interfering with the local muscular and nervous

mechanisms in the wall of the intestine and also that paralysis may result from indirect irritation through a reflex involving the splanchnic nerves.

Purgatives traumatize the intestine from within in very much the same manner as do mechanical manipulations from without. This in addition to being a matter of universal clinical experience, has been amply demonstrated experimentally by Alvarez and Taylor.[34]

D. THE ALLEGED RÔLE OF MORPHINE: The action of morphine on intestinal motility is ordinarily assumed to be one of inhibition of peristalsis and decrease of tone. Accordingly, it is usually believed that the preoperative and postoperative use of morphine subjects patients to the danger of developing intestinal stasis or actual ileus. Aversion to the use of morphine preoperatively and postoperatively is apparently, in part at least, a relic of a former misapprehension, born in the days when the pain caused by operative procedures was much more intense than at present, and morphine was required more frequently and in larger doses. During this period, in which excessive operative trauma was the rule, postoperative ileus occurred with distressing frequency, and the administration of the alkaloids of opium which had to be copious to relieve the pain came to be associated with the development of ileus in the minds of surgeons: a good example of the "non-sequitur" in surgical logic. No very good evidence, either clinical or experimental, has ever been produced to show that the use of morphine is of much etiological importance in the development of intestinal paralysis.

King and Church,[5] studying the effect of certain drugs on the motor activity of the muscularis mucosae of the dog, found that morphine was without effect either on tone or on rhythm, except when given in very large doses. Doses of less than 16 mg. were without effect, but doses larger than this occasionally acted as a depressant, although sometimes as much as 40 mg. showed no depressant effect at all. Nothnagle,[6] in 1882, used the etherized rabbit in testing the motility of

the small intestine, and by touching the intestinal wall with crystals of sodium chloride found that subcutaneous injections of morphine decreased the irritability of the gut. He concluded that moderate doses of morphine stimulate the splanchnic or inhibitory nerves to the intestines and that larger doses paralyze these nerves. He attributed the constipating effects of such doses of morphine, therefore, to splanchnic stimulation. Spitzer,[7] in 1891, repeated Nothnagle's experiment on non-etherized rabbits and was able to confirm the observations previously made, except that he observed that contractions did not always remain localized at the point of stimulation. He found also that the same effect was produced even though the mesentery was cut. Pal,[8] in 1900, using curarized dogs and recording the movements of the gut graphically by means of balloons introduced into the lumen of the intestine, found that intravenous injections of morphine and opium, both in small and large doses, invariably increased the tone of the gut and stimulated rhythmic contractions. This occurred even in cases in which the nerve supply to the loop of intestine had been divided. He believed that the effect of morphine depended upon stimulation of the ganglia in the wall of the intestines. Magnus,[9] in 1906, repeated Nothnagle's original experiment on etherized rabbits, but was not able to demonstrate any decreased excitability due to the injection of moderate doses of morphine. Larger doses of morphine, however, he found frequently increased the irritability of the gut and often led to the production of spontaneous contraction even in the absence of stimulation. In 1908, Magnus[10] attempted to determine the pharmacological action of morphine on the small intestine by the fluoroscopic method. He showed that constipating doses of morphine and opium had no marked effect on the small intestine. The stomach did, however, show delay in emptying, apparently due to vigorous contractions in the region of the pyloric antrum. He believed, therefore, that constipating effects of morphine are due to delay in the emptying time of the stomach. He confirmed his observations on dogs. Rodari,[11]

observing the exposed intestine in anesthetized rabbits, found that the injection of opium produced peristalic waves which persisted from one to two minutes and were followed by a condition of contracture. Schapiro,[12] in 1913, observed the movements of the alimentary canal in human subjects after injections of morphine and opium. He noted variable effects. Usually the contraction of the small intestine after passage of food through this part of the gut was not affected. Sometimes the contraction and tone were increased. A few cases showed delay in emptying of the small intestine which seemed to occur at the ileocecal valve. In about half of his cases the stomach was found to empty slowly. Occasionally, however, there was an acceleration of the emptying time. He attributed the constipating effect of morphine to loss of the "defecation reflex." Uhlman and Abelin,[13] in 1920, observed the effect of opium on the intestine of etherized rabbits and guinea pigs. They found that although small doses of opium decreased the tone of the intestine and inhibited peristalsis, larger doses caused distinct increases both of tone and contraction. Plant and Miller,[14] using dogs in which a Thiry-Vella fistula had been made and in which observations were recorded by mechanical means after complete recovery of the animals from the operative procedure had occurred, found that the effect of morphine on the muscular activity of the small intestine was very constant. There was always a decided increase in tone which sometimes amounted to a condition of spasticity. Peristalsis occurred after a period of initial inhibition, and the peristaltic waves showed a distinct increase in frequency. They were often higher and broader than before. Small rhythmic waves, which were noted and were interpreted as being segmentation waves, were usually increased in amplitude, but were not increased in number. Dogs observed over a period of weeks, during which time there were regular daily injections of from .1 to 5 mg. of morphine per kilogram of body weight, showed no noticeable change in the number or character of the stools per twenty-four hours. These authors also studied the

effect of morphine on the small bowel of a man who presented a fistula in the ileum. The results were the same as those in the dog. There was an increase in tone accompanied by an increase in amplitude of the waves and an increased rate of peristalsis. Various other alkaloids of morphine, viz., heroin, codeine, papaverine, narceine, and narcotine, were found to produce effects similar to those produced by morphine but in much less degree. Plant and Miller[14] reported the effect of repeated small doses of morphine. In these experiments they also used the Thiry-Vella fistula and the graphic method of recording peristaltic movement. Kymographic records taken on the tenth, twenty-ninth, fiftieth, and seventy-first days of the experiment showed typical reactions to morphine consisting of decided increase in tone, amplitude, and frequency of peristaltic waves.

In view of this experimental evidence there would seem to be very little reason for apprehension with respect to the development of either distention or postoperative ileus as the result of the administration of morphine or indeed any of the other alkaloids of opium as ordinarily practiced in the treatment of preoperative and postoperative cases. Clinical observations would seem to coincide with the theoretical and experimental considerations. Certainly clinical cases of ileus definitely ascribable to the use of morphine do not find their way into the literature, and those who fear to use morphine because of its supposedly baneful effect on intestinal movement have apparently been victimized by a tradition passed on from former days.

E. The Nature and Source of the Gas of Intestinal Distention: Gas pains, as previously mentioned, represent ineffectual attempts of the intestine to empty itself against pressure. This ineffectuality of peristaltic activity is presumably partly due to the nature of the substance contained within the intestinal lumen and partly to the fact that the same factors which are instrumental in producing the initial quiescence also disturb the normal muscular and nervous

mechanism of intestinal motility to such an extent that motor responses of the intestinal tract when first resumed tend to be disorderly and valueless.

Mechanical trauma, the action of cathartics, and possibly to some extent, proctoclysis undoubtedly combine in predisposing to such disorderliness in resumption of function, and accordingly gas pains tend to be maximal when such factors are maximal, and minimal when such factors are minimal.

In considering deranged motility as of etiological importance in the development of distention and gas pains, however, sight must not be lost of the fact that fundamentally deranged motility is a predisposing rather than an exciting cause of the complications under discussion; the equally important and correlative factor is the gas content of the intestinal tract. Gas, because of its peculiar physical properties, is expelled by peristaltic activity with much greater difficulty than either liquids or solids, and consequently distention, once established, tends to be persistent.

In conditions of health small amounts of gas are present in the intestine. The amount of such gas is insufficient to cause annoyance, and ordinarily a person is, therefore, unaware of its presence. The origin of intestinal gas is threefold: (1) the decomposition of foodstuffs, (2) diffusion of gas from the blood stream, and (3) swallowed atmospheric air.

1. *Decomposition of Foodstuffs:* There is evidence for believing that considerable quantities of gas are formed during the normal process of digestion. It occurs primarily in the form of carbon dioxide and is apparently formed as follows: (a) By the action of the acid gastric contents on the carbonates secreted in the alkaline biliary and pancreatic secretions: von Bungle[15] has estimated the amount of gas thus produced at 6 l. daily. (b) By the action of bacteria on sugars in the lower portion of the small intestine: Apparently in health the amount of carbon dioxide thus formed is negligible, for virtually all of the starches and sugars are reduced by the action of digestive enzymes to monosaccharids in the upper portion of the small

intestine and these monosaccharids are completely absorbed, leaving no residue. (c) By the action of bacteria on any residue of cellulose which remains after digestion is complete: In man no digestive enzyme capable of splitting cellulose is secreted in the digestive juices. The end-products of cellulose decomposition by bacteria are carbon dioxide and fatty acids; the latter doubtless become neutralized by alkaline carbonates secreted in the proximal portion of the colon with the production of still more carbon dioxide.

The other gases present in the normal intestines occur only in traces. These gases are marsh gas, which has the formula CH_4, hydrogen, indole, skatol, hydrogen sulphide, and ammonia. Except for marsh gas and hydrogen, these gases must be derived entirely from the putrefaction of proteins.

Fries[16] has estimated that the volume of gas discharged daily through the rectum in health amounts to about 1 l. Inasmuch as much more gas than this is formed, the conclusion is obvious that a large percentage of the gas must be excreted through other channels. Tacke,[17] working with rabbits, found that from ten to twenty times as much intestinal gas was eliminated from the body by the lung as by direct expression from the lower bowel.

Inasmuch as patients subjected to ordinary operative procedures come to the operating table with a relatively empty gastrointestinal tract, and because at the time of the preoperative procedure such patients show no evidence of flatulence or distention, the occurrence of distention postoperatively in such cases can scarcely be attributed to any of these factors. Furthermore, as far as carbon dioxide itself is concerned the production of large quantities of this gas could scarcely lead to any undue degree of distention under ordinary circumstances, because carbon dioxide is very rapidly absorbed by the blood and exhaled from the lungs. Experimentally, Kato[18] showed that when carbon dioxide is artificially introduced into the small intestine at least 90 per cent of the gas is rapidly absorbed. Only in cases in which the venous drainage

from the small bowel was interrupted could carbon dioxide remain in considerable amounts. Thus he showed that if the portal vein was ligated only 40 per cent of the gas was removed from the intestinal lumen instead of 90 per cent within a given unit of time. Ligation of the portal vein, however, is, of course, inconsistent with life, as is any considerable interference with the venous return through the portal vein. Kantor and Marks[19] believe that a certain amount of flatulence may be caused by defective splanchnic circulation. They present evidence to show that flatulence is frequently associated with hypertension and is a common occurrence in arteriosclerosis, particularly in mesenteric arteriosclerosis. It is possible that damage to the intestinal mucosa, as by inflammation or operative trauma, accompanied by overproduction of mucus, may cause diminished absorption of carbon dioxide from the intestinal lumen. Schoen,[20] however, showed experimentally that when he poured corrosive fluids into the small intestine no interference with gas absorption occurred.

In cases in which residues from the digestion of vegetables rich in cellulose remain in the large intestine at the time of operation considerable gas might be formed by the action of bacteria on the cellulose, although clinical symptoms would hardly result because there is every reason to believe that this gas would be rapidly absorbed, consisting as it does of carbon dioxide. Such vegetables as cabbage in the form of cooked cabbage or sauerkraut and slaw, cauliflower, Brussel sprouts, carrots, turnips, beets, and the leguminous vegetables, peas and beans, contain considerable amounts of cellulose in the form of tough membranes which enclose starch granules. Patients who immediately prior to operation had eaten quantities of such vegetables and in whom intestinal evacuation had not subsequently occurred would be particularly liable to distention from this source. However, such articles of diet are not ordinarily supplied to patients in the days just preceding abdominal operations and can hardly play any considerable rôle in the development of ordinary postoperative

distention. Actually such analyses of the gas of postoperative distention as have been made indicate that carbon dioxide plays a very unimportant rôle in the etiology.

2. *Diffusion of Gas from the Blood Stream:* As McIver, Redfield, and Benedict[22] have shown nitrogen itself may be derived from the blood by a process of diffusion. These observers found that when either oxygen or nitrogen was injected into isolated loops of the small intestine the gas in the intestine underwent a progressive change in composition, in accordance with which the oxygen or hydrogen disappeared, and its place was taken by nitrogen. Nitrogen itself, of course, occurs in the blood stream in simple solutions under a partial pressure of about four-fifths of an atmosphere. Oxygen and carbon dioxide, however, occur in the blood stream in chemical combination. Thus the nitrogen is free to leave the blood stream and replace other gases in the intestinal lumen when pressure relationships are favorable; whereas, in order for oxygen or carbon dioxide to leave the blood stream, not only must pressure relationship be upset, but also conditions must be produced favorable to the chemical liberation of these gases.

3. *Swallowed Atmospheric Air:* The most recent analyses of gas from postoperative cases as performed by McIver and his associates[22] have shown that intestinal gas obtained from postoperative cases presents a composition closely resembling atmospheric air. It is composed essentially of nitrogen, four parts, and oxygen, one part; only small amounts of carbon dioxide and traces of other gases, such as methane and hydrogen sulphide, were found.

E. B. Benedict[22] has determined experimentally, that all of these gases pass between the intestinal lumen and the blood stream in accordance with the well understood physical laws of the diffusion of gases, a condition of equilibrium existing only when the partial pressure of a given gas within the lumen of the intestine is equal to the mean pressure of the gas in the blood stream. Normally, the amount of gas in the intestinal lumen is minimal for the reason that gases diffuse into the blood

stream about as rapidly as they are formed. The presence of distention, however, is an indication that there exists a process of unstable equilibrium and that accumulation is more rapid than diffusion.

The rates of diffusion for various gases found characteristically in distention have been experimentally determined by introducing measured amounts of these gases into closed loops of intestine in cats and subsequently measuring accurately the amount of absorption which occurs per unit of time. The number of cubic centimeters of various gases absorbed from a loop of intestine 25 in. long per hour are represented essentially as follows:[22]

CO_2	H_2S	O_2	H_2	CH_4	N_2
160	69	14	7	2	1

As previously stated, the percentage composition of the gas of intestinal distention is very nearly that of atmospheric air as far as the proportion between its main constituents, nitrogen and oxygen, are concerned; the other constituent gases occur in somewhat greater proportions than are found in atmospheric air, but the absolute amount of such gases is small.

These considerations offer rather convincing evidence (1) that the gas of intestinal distention is derived mainly from the swallowing of atmospheric air, (2) that the process of eliminating the gas of distention is largely one of diffusion rather than actual expulsion, (3) that intestinal putrefaction upon which must depend the presence of such gases as hydrogen sulphide and methane is to be reckoned with only as a minor factor in the production of distention, and (4) that diffusion of gases from the blood stream into the lumen of the intestine is a negligible factor in the formation of distention because diffusion acts as a mechanism tending toward equilibrium rather than the reverse.

The importance of air swallowing in the production of distention and gas pains is clinically attested by the frequency with which distention follows the unskilful induction of general anesthesia, during which the patient strains, gags, swallows,

and vomits, every forceful expulsive action of the patient being followed by a correspondingly forceful impulsive reaction. Considerable air swallowing probably also occurs during the period of reaction from general anesthetics. Preliminary gulping and swallowing usually precedes vomiting or attempts at vomiting.

The preceding discussion is believed to indicate the essential factors concerned in the development of distention and gas pains.

The causative factors in distention are mainly two: (1) air swallowing and (2) relaxation of the intestinal musculature due to adynamic ileus. To these must be added the less important contributing factors, (3) intestinal putrefaction and (4) possibly some stagnation of the splanchnic circulation due partly to lack of motility and partly to traumatic shock, a stagnation which interferes with the normal diffusion of gases from the intestinal lumen. The predisposing factors in the production of "gas pains" are (1) interference with normal intestinal motility in accordance with which intestinal contractions become disorderly and inefficient, and (2) the nature of the contents of the intestinal tract which, being gaseous, cannot easily be propelled and expelled. On the basis of these considerations the rational treatment of "gas pains" must be founded.

II. Prophylactic Treatment

Splanchnic and spinal anesthesia tend to be followed by a minimum of distention and gas pains. Splanchnic block, which is common to both these forms of analgesia prevents the delivery of inhibitory impulses to much of the intestinal musculature. The result is that paralysis of the intestine is reduced to a minimum. The tonicity of the intestinal wall also being largely preserved and intestinal movements tending to persist, air does not easily find its way into the digestive tract and such air as does become imprisoned thus tends to be passed on and expelled. *Per contra*, under conditions of general anesthesia,

the intestinal wall tends to become maximally paralyzed, and, in addition, the nature of the process of induction and reaction from anesthesia is such that air swallowing is facilitated. From the point of view of distention and gas pains alone, therefore, spinal and splanchnic anesthesia presents obvious advantages over inhalation anesthesia.

General inhalation anesthesia, however, presents certain general advantages which are usually accepted as outweighing such minor disadvantages as the one under discussion and general anesthesia, therefore, rightly remains the anesthesia of choice in most operative procedures. In the use of such anesthesia, the prophylaxis of distention and gas pains should be carefully considered. Particular attention should be paid to the manner of induction; the patient who "takes the anesthesia" poorly may be expected to develop the complications under discussion in maximal degree.

As far as intestinal trauma is concerned the particular indications to be observed are the avoidance of unnecessary, unskilful, and inconsiderate intra-abdominal manipulations, and the avoidance of preoperative catharsis.

The administration of proctoclysis, though theorectically possibly contraindicated from the point of view of the particular complications under discussion, serves such obviously beneficent functions otherwise that a slight tendency to undesirable side actions constitutes no valid objection to its use.

III. Active Treatment

Granting that the mechanism of distention and gas pains has been accurately stated, it will readily be seen that these complications are fundamentally self-limited conditions. Postoperative intestinal accumulations of gas are dissipated primarily not by mechanical evacuation or expulsion, but by absorption into the blood stream. The rate of absorption cannot readily be hastened artificially because it depends upon pressure relationships and the percentage composition of the contained gas, factors which for the most part cannot be

controlled. Fundamentally time alone is capable of dealing with the situation once distention has become established.

Much difficulty arises when these facts are not appreciated, because the tendency then is to attempt to increase peristalsis in an effort to favor mechanical expulsion of the gas; enemas are given and drugs are administered with the idea of whipping the sluggish intestine into action. The results of such therapy are not only theoretically irrational but clinically disappointing. Such measures only exaggerate muscular incoordination and delay resolution.

A. The Use of Enemata: Enemata produce their characteristic action by irritating the mucosa of the rectum, sigmoid, and colon, thereby producing violent contractions of those structures; probably also to a certain degree by causing sympathetic reflex contractions of the small intestine. The gas of distention is not confined to the large intestine, and even were this the case the pressure of peristalsis would probably not be needed to evacuate it provided only that the resistance of the rectal sphincters was relieved, as can so readily be accomplished by the insertion of a rectal tube. When enemas are given an amount of gas is expelled similar to that recoverable by the use of a rectal tube alone, and not infrequently a period of symptomatic relief follows; but if the abdomen be carefully examined subsequently little actual decrease in girth will be noted at the time, and within a very few hours distention frequently will be found to have increased, and all the patient's symptoms will have undergone a distinct exacerbation. The explanation is apparent. The initial relief results from expulsion of colonic gas due, not to stimulation of peristalsis, but rather to simple relief of pressure incident to the mechanical opening of the rectal sphincters. The exacerbation represents a reactionary goading of peristaltic action in the small intestine which is purposeless and valueless partly because the movements are not properly coordinated and partly because of the inherent difficulty of expelling gas by the mechanism of peristalsis, even in the presence of orderly

movements. If now another enema be given the patient the cycle of events is repeated, and the latter condition of the patient becomes progressively worse than the first, because frequent peristalsis easily leads to motor exhaustion.

B. The Use of Stimulating Drugs: A number of drugs have been devised and used at various times for their supposed stimulating effect on intestinal movements. Of these probably the most familiar and widely used are eserine and pituitrin.

1. *Eserine*, or *physostigmine*, is the active principle of the calabar bean. For nearly fifty years this drug has been used clinically for its stimulating action on intestinal motility. Fröhner[23] states that as early as 1882 Dickerhoff made use of the drug in the practice of veterinary surgery for the relief of obstruction in animals. Westermann, however, in 1867 reported the occurrence of tetanic contraction of the intestinal wall in cats, rabbits, and dogs, following the administration of a 2.5 per cent glycerin solution of the alcoholic extract of the calabar bean.

Alvarez,[24] Cross,[25] and Baur[26] have examined the effects of eserine on isolated strips of smooth muscle from the intestinal tract of experimental animals. They have found generally that the action of eserine is to increase the tone of the musculature and to produce increases in the amplitude of intestinal contraction. The action of the drug seems to depend upon either a direct stimulation of the motor end plates of smooth muscle or the plexuses contained within the intestinal wall, or possibly the drug increases the irritability of these structures to motor stimuli. LeHeux[27] and Brunner and Weigand[28] were able to observe increases in intestinal movement under the fluoroscopic screen following the exhibition of physostigmine. Oppenheim,[29] Bauer,[30] and also Cannon and Murphy[1] observed active stimulation of the motor mechanism of the intestines at laparotomy in experimental animals. Ross,[31] McIntosh and Owings,[32] and Ochsner, Gage, and Cutting[33] recorded the effect of eserine on the intestinal canal of intact animals graphically. The results obtained by these investi-

gators in general confirm the observations of previous workers; increases in intestinal tone and movement were noted.

Among the early clinicians to use eserine were Hiller,[34] Subbotin,[35] and Schaefer,[36] who used the drug to combat flatulence and atony of the intestine. During the early years of the present century clinicians were in the habit of attempting to induce active movements of the bowel within a relatively few hours postoperatively. A number of authors during this period used eserine salicylate both prophylactically and curatively with apparent success (Noorden, Packard, Arndt, Vogel, Craig, Goth, Moeninghoff). In more recent years eserine has been used with success in the treatment of intestinal atony by Martin and Weiss,[37] Vogel,[38] Bartlett,[39] and Cross.[25] Martzloff,[40] however, working in the Johns Hopkins Hospital, has made an unfavorable report on the basis of a study of the use of a combination of eserine and strychnine prophylactically in 162 cases subjected to major abdominal operations under ether anesthesia. His investigation was well controlled, and he found that in patients receiving this prophylactic treatment for distention and gas pain, emesis, and distention occurred more frequently in treated cases than in untreated ones and that voluntary micturition was reestablished earlier in the non-treated cases than in the treated cases. He concludes that no benefits may be expected to result from the preoperative use of eserine and strychnine in the prophylactic treatment of these conditions. In criticism of the work of Martzloff[40] it has been contended that too small doses of the drug were used, and furthermore that the drug was used prophylactically and not curatively.

Because of the fact that almost all of the reports, both experimental and clinical, on the use of eserine in the stimulation of intestinal movement have been favorable, there seems to be little room for doubt that eserine may be of value in any condition in which stimulation of intestinal motility is indicated; but there still seems to be some doubt as to whether eserine as usually administered to patients is actually of real

value in combating the more severe degrees of intestinal atony. Certainly the results obtained in experimental animals by the injection of eserine are not quite so pronounced or striking as certain of the clinical and experimental observations would lead one to suppose. A representative tracing of the effect obtained by the injection of $\frac{1}{50}$ grain of eserine sulphate into the dog is reproduced (Fig. 42). Although a noticeable increase in tone follows the injection of the drug, the increase in intestinal movement which follows is not particularly marked, and it seems rather doubtful whether so slight an augmentation in tone and motility would be capable of producing any very startling effect in the actual expulsion of material from the intestinal tract. Furthermore, certain investigators, notably Moennighoff,[41] have observed satisfactory movements of the bowel only in case the drug treatment was supplemented by the use of an enema. Moennighoff believes, for this reason, that physostigmine acts only on the small bowel, but unless this can be demonstrated, it seems more rational to believe that the action of eserine is perhaps the same throughout the entire intestinal tract, as apparently shown by Bauer and others, and the effect of enemata is additive and supplemental. This view of the relative inefficiency of eserine is held by many of those who have worked clinically with physostigmine, notably Ross and Martzloff.

2. *Pituitrin, Pitocin:* Pituitrin is regarded by most practitioners as a drug of especial value in the stimulation of intestinal motility. Oliver and Schäfer[42] were able to show that extracts of the pituitary gland are capable, under certain circumstances at least, of stimulating contraction in smooth muscle and thus paved the way for the clinical use of the drug in the stimulation of intestinal movement. Blair Bell[43] and his pupils were among the first to make use of pituitary extract clinically for its motor effect upon the intestine. Blair Bell found that defecation occurred following the use of these extracts and believed that intestinal motility and tone were increased by pituitrin. He found, however, that frequently

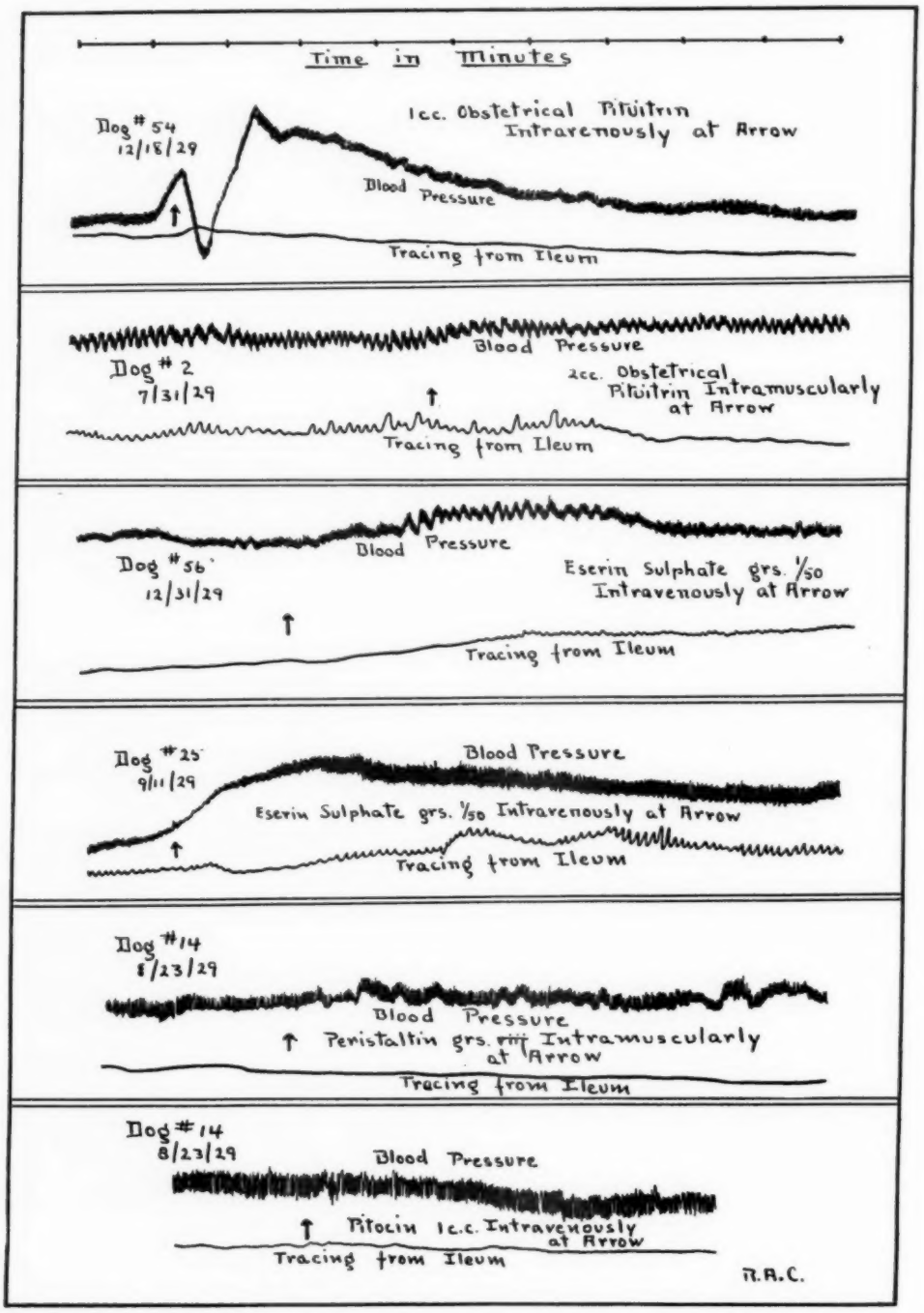

FIG. 42. Kymographic tracings, greatly reduced, of motor action of some of drugs commonly used for alleged stimulating effect on intestinal musculature. At top of page

a period of relaxation preceded the institution of a strong contraction.

The experimental investigation of the action of pituitrin on the intestinal musculature has yielded some very interesting but inconclusive evidence. Certain investigators have attributed to pituitrin a stimulating action, whereas others have found characteristically the exact reverse. Among those who have found pituitrin stimulating to the intestinal musculature are Fodera and Pittau,[44] Guggenheim,[45] Young,[46] Roth,[47] and Dixon.[48] King and Church[5] also found a stimulating action on isolated intestinal muscle, but they were never able to obtain this effect by injecting pituitrin into living animals. Cross[25] was able to produce slight increases in tone in the musculature of pieces of human appendix removed at operation. Kaufmann[49] found that pituitrin caused a definite stimulation of the ileum in both cats and rabbits, but that no such effect was encountered either on the duodenum or jejunum. Young[46] found that although the watery solution of pituitary substance was effective in promoting intestinal movement, the alcoholic extract was not. Dixon[48]

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is a time-marker tracing indicating minutes; with this all of the tracings subsequently reproduced can be compared since all tracings have been reduced to scale. Tracings recorded in each of transverse panels were similarly obtained and are therefore directly comparable, blood-pressure tracing in each case being a manometer record taken from left carotid artery, and tracing from ileum being recorded by means of thin rubber balloon placed within lumen of gut and connecting with recording tambour by means of rubber tubing. Dogs were used as experimental animals and were manipulated under barbital anesthesia.

Two upper panels represent effect of pituitrin; note inconstant effect of drug on blood-pressure, decrease in tone of gut after injection of substance in both cases, and definite *inhibition* of movement in second case. These are usual effects of pituitrin; *very rarely* pituitrin has been seen to increase tone and movement slightly.

The succeeding two panels represent characteristic effect of eserine. Note consistent slight increase in blood pressure following injection of drug and general tendency toward increase in both tone and motility of gut. Stimulatory action of eserine is rather constant but relatively feeble.

In two lower panels effects of peristaltin and pitocin have been reproduced; these drugs are apparently inert both with respect to blood-pressure and intestinal movement.

Tracings obtained after injection of choline and acetylcholin show no effect on gut although both drugs depress blood-pressure; tracings illustrating action of these drugs were omitted in order to avoid monotony.

found that, even though pituitary extract caused an increase in the movements of the small intestine, it produced the opposite effect on the large gut. Brunner and Weigand[28] apparently confirmed this observation under the fluoroscope, using cats.

Among those who have noted the production of relaxation rather than contraction following the administration of pituitrin may be mentioned Bayer and Peter,[50] who found that contractions occur only occasionally and always after a period of relaxation, Shamoff,[51] who noted relaxation and inhibition of rhythmic contraction, and Hoskins,[52] Pancoast and Hopkins,[53] Atwell and Marinus,[54] and MacDonald,[55] who believe that extracts of pituitary gland vary greatly in their content of intestinal stimulant and that the pituitary gland is not particularly richer than several other tissues. McIntosh and Owings[32] have noted slight relaxation or no change at all following pituitary injections in both normal and obstructed loops of bowel. Roth[47] believes that when the stimulating effect of pituitary extract is not seen, the explanation is to be found in contamination of the preparation with chloretone. Degener[56] has likewise seen a characteristic inhibitory action of the extract of the posterior lobe of the pituitary. Voegtlin,[57] using rats as experimental animals, found inhibition of both tone and pendular movement even with a carefully prepared chloretone-free and histamine-free preparation of pituitary extract. It should be emphasized furthermore that most of the favorable reports on the stimulating action of pituitrin have been made not by experimental but by clinical investigators, Bidwell,[58] Duffey,[59] Mayer,[60] Vogt,[61] and Krinsky.[62]

Certainly the ordinary effect produced by commercial pituitrin on experimental animals is one of loss of tone and diminution in the amplitude of contraction. A characteristic tracing of such an effect is reproduced herewith. It should, however, be remarked that in occasional instances the administration of pituitrin is followed by the opposite effect, viz., an increase in tone and an increase in the amplitude of intestinal contraction. This exceptional effect has apparently

been sometimes observed clinically and has been responsible for the extravagant claims of clinicians.

Pitocin: Apparently because of a recognition of the generally unsatisfactory character of pituitrin itself a special extract of pituitary gland called "pitocin" has been placed on the market. This drug is supposed to exert a universally stimulating effect on the intestinal musculature, and, therefore, should be preferable to pituitrin. Experimental investigations conducted on this drug by Ochsner, Gage, and Cutting[33] apparently showed that pitocin is quite worthless as an intestinal stimulant. Not only have increases in intestinal tone and movement been conspicuous by their absence when "pitocin" has been used, but also the occasional stimulatory effect shown by pituitrin has never been seen when this drug has been used. For this reason "pitocin" would seem to be of even less value than pituitrin, although it must also be admitted in fairness to "pitocin" that it does not produce the depression of tone and cessation of intestinal movement which is characteristic of pituitrin. A representative effect of "pitocin" administration is herewith reproduced.

3. *Other Drugs, Choline and Acetyl Choline, Peristaltin: Choline and Acetyl Choline:* In 1912 Weiland[63] made the accidental discovery that when isolated strips of intestine were allowed to contract for considerable periods of time in Ringer's solution, the Ringer's solution could thereafter be shown to exhibit a stimulating effect when brought into contact with fresh pieces of intestine. The substance responsible for this reaction was isolated by LeHeux[64] in Magnus's laboratory at Utrecht and was called "choline." Magnus thought that this substance was the hormone responsible for the regulation of intestinal motor activity, because he found that it was without action on the uterus or the heart and invariably acted as a stimulant to the intestinal musculature. Magnus,[65] in 1925, stated that the isolated small intestine of the rabbit gives off 3 mg. of choline from its mucosal surface per hour. He believes that this substance activates the plexus of Auerbach, for, if

this plexus be removed from isolated muscular strips, the tolerance for choline is much increased. The action of choline as an intestinal stimulant has been corroborated by a number of investigators, notably Grossmann,[66] Guggenheim and Loeffler,[67] and Dale.[68]

Apparently certain organic acid derivatives of choline are more efficient in the stimulation of intestinal movement than is choline itself. The effect of the acetic acid derivative, acetyl choline, has been stated to be a thousand times as intense as that of choline itself (Wolfe and Canney[69]). LeHeux,[70] in 1921, experimented on the choline esters of succinic, pyruvic, butyric, isovaleric, and benzoic acids and found that all of these esters, with the single exception of the succinic acid ester, were more powerful than choline itself. Choline and acetyl choline have been used with some success clinically, especially by German practitioners, but apparently these drugs do not possess the salutary clinical results which might be expected from a consideration of many of the experimental investigations. Indeed, Carlson, Smith and Gibbens,[71] and Ochsner, Gage, and Cutting[33] have produced experimental evidence to show that the action of choline and its esters is neither constant nor conspicuous.

Peristaltin: Peristaltin, a preparation of the soluble glucoside of cascara sagrada suitable for hypodermic injection, is supposed to have a specific stimulatory action on the intestinal musculature. The drug has as yet been subjected to little experimentalin vestigation, but Ochsner, Gage, and Cutting[33] have presented experimental evidence, indicating that this substance is of relatively little value. No significant effects have been seen on the intestine of intact animals following its intravenous injection. A tracing showing the typical action of the drug is herewith reproduced (Fig. 42).

A consideration of the foregoing rather lengthy discussion brings the value of the drug therapy of distension and gas pains into very serious question not only from the point of view of misapprehension as to the end to be achieved, but also

with respect to the action of the aforementioned agents in accomplishing that for which they were designed. All in all, the drug therapy of intestinal distention, in general, and gas pains in particular stands on very precarious ground. This is as true clinically as it is theoretically. Although brilliant results may occasionally be encountered as the result of the use of drugs, every clinician of experience knows that the usual effects are very disappointing.

Therefore, as the expulsion of gas in postoperative intestinal distention cannot be well induced either by unaided intestinal peristalsis or by reinforcement of the intestinal movements by physical or pharmacological means, the treatment of distention and gas pains is largely expectant. This does not at all mean that nothing can be done to make the patient's suffering from distention or gas pains more comfortable, but rather that, whatever is done, time alone can solve the problem satisfactorily. Hence, instead of attempting to induce intestinal contractions, which are painful and inefficient, the opposite result should be sought, and means should be employed to induce and maintain intestinal quiescence. This, and this alone, will ensure for the patient the maximum amount of comfort because it will provide the greatest cubical capacity for the gas contained within the intestines and consequently will reduce intra-intestinal pressure to a minimum.

c. The Use of Morphine: Morphine may be given without compunction for the relief of gas pains if necessary, but gas pains characteristically occur at a time when the administration of morphine is not particularly desirable, for usually the acute postoperative traumatic or incisional pain has largely disappeared before the onset of gas pains, and the administration of morphine has therefore been discontinued by the medical attendant, perhaps with a feeling of relief because of a conviction that too many doses have already been required. The resumption of morphine medication may occasionally be required in the severe cases, but much relief can be given by using simple physical measures.

D. The Relief of Mechanical Tension Due to Tight Bandaging: As stated previously in connection with the general discussion of postoperative care, a moderate degree of disten-

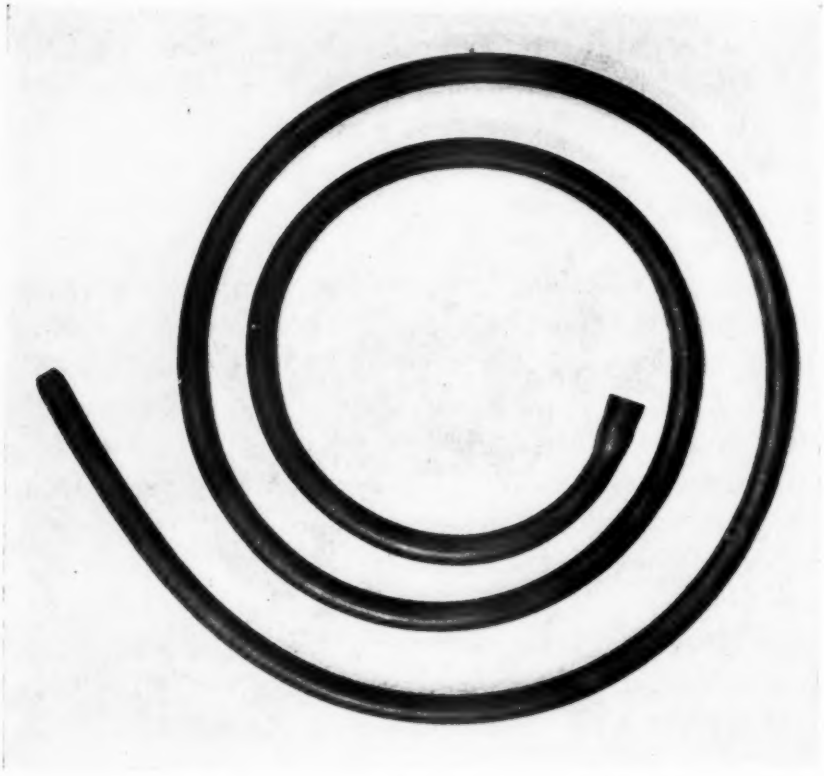

Fig. 43. Usual type of soft rubber rectal tube.

tion may be greatly accentuated by the presence of a tight restraining abdominal dressing. Some surgeons habitually make use of voluminous dressings and wide adhesive plaster straps extending from flank to flank and sometimes almost from symphysis pubis to the ensiform process of the sternum. Occasionally such a dressing may be necessary, but usually it serves no useful function and causes the patient much discomfort. If such a dressing has been used, and marked abdominal distention occurs the thoughtful medical attendant will carefully remove the unnecessary restraining strips of plaster

or will slit them in such a manner as to relieve tension as much as possible, or at least as much as he deems safe.

E. THE USE OF STOMACH AND RECTAL TUBES: If this simple

FIG. 44. Gastric or duodenal tube of the Jutte type. Tube proper consists of relatively thin rubber, and its caliber is relatively small; metal tip is tied into the end; tube is perforated for a short distance proximal to tip by a series of small holes, too small to be well seen in illustration. Jutte tube differs from Levin tube (Fig. 45) in thinness of wall, small size of perforations, and metal tip.

procedure does not make the patient reasonably comfortable the surgeon must not forget that at least a portion of both the upper and lower ends of the intestinal canal can be relieved of pressure directly by means of intubation. A rectal tube passed well into the lower bowel will in a short time evacuate gas

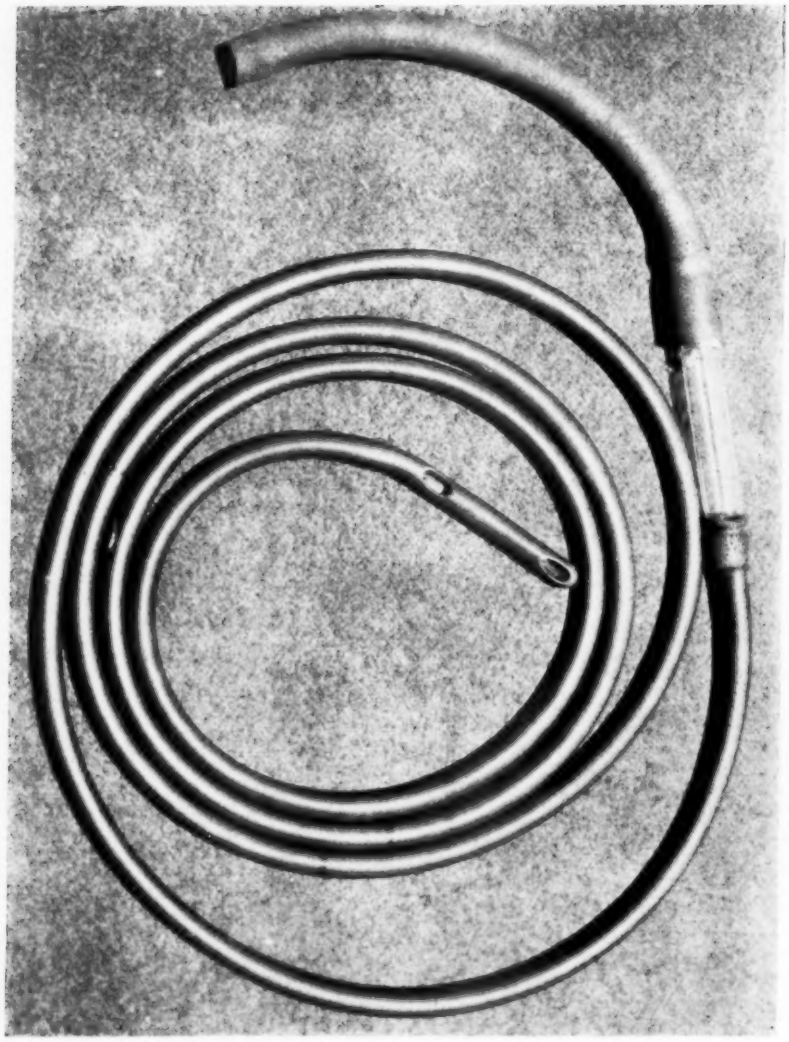

FIG. 45. Gastric or duodenal tube of the Levin type. Tube is essentially a long, slender, flexible catheter with four or more "velvet eyes" at the tip. Length of tube is from 45 to 60 inches, and it is made in various calibers, 16, 14, 10 F.; the first named is the best size for adults. Tube is marked with black circles 18, 22, and 26 inches from its tip. Levin catheter is designed to be introduced through patient's nose; it is soft and pliable, consequently easily introduced; being small in caliber it causes patient little inconvenience; it finds its way into the duodenum as readily as tubes with metal tips; because of its mechanical features it does not easily become clogged; probably such a tube is not so likely to produce trauma or pressure necrosis as a tube with a metal tip, especially when circumstances dictate prolonged continuous use.

from at least a considerable part of the colon, and a stomach tube passed, either through the mouth or, if need be, through the nose, will almost immediately empty the stomach and probably much or most of the duodenum (Figs. 43 and 44). Though it has been emphasized in the preceding pages that the intestine is impotent to empty itself of contained gas for some time postoperatively this is true only of portions somewhat removed from either end of the tract; even disorderly intestinal movements in portions of the gut near the stomach will be capable of regurgitating some gas into this viscus and, similarly, contractions of the terminal portion of the ileum, even though incoordinated, will pass some gas into the colon. The rectal tube and stomach tube afford fairly direct avenues of exit for such accumulations. The two simple expedients just mentioned add very much to a distended patient's comfort.

F. THE USE OF HEAT: Heat tends to relax muscular spasm, and this principle may be used to good advantage in cases in which gas pains are persistent in spite of the measures previously described. The time-honored turpentine stupe has relieved many a patient of distention and gas pains. Whether the turpentine used in the preparation of stupes has any particular value in itself is open to serious question; turpentine is a local irritant and rubefacient and shares the somewhat questionable advantages of other counterirritants. Undoubtedly the primary beneficent action of stupes is dependent upon their heat content. Probably in some cases, particularly in very thin persons, direct transmission of heat is possible through the skin and subcutaneous tissues to the musculature of the anterior abdominal wall; however, many patients present an intermediate pad of abdominal fat through which locally applied heat does not, in all probability, penetrate for any considerable distance. For this reason, probably most of the effect of the local application of heat is dependent upon reflex sedation. Both the abdominal musculature and the intestinal musculature respond clinically.

The hot stupe is not, however, really the most desirable form of heat application, provided that the therapeutic action of turpentine be not considered of particular importance. Considerable portions of the abdomen, as previously mentioned, are characteristically covered by dressings, and therefore the available surface to which stupes may be applied is ordinarily somewhat restricted. Furthermore, stupes not only impose an unwelcome burden of weight on the patient's distended abdomen, but they speedily lose heat and to be effective must therefore be frequently changed, a procedure which is burdensome both to patient and nurse.

The electric light tent or cradle is not subject to any of these disadvantages and presents certain additional desirable characteristics. It not only imposes no extra weight upon the patient's abdomen, but it relieves the burden of the bed clothes as well. Heat is applied not only to exposed portions of the abdomen but also to the part covered by dressings and the flanks. The supply of heat, furthermore, is constant and can be regulated at will. Clinically, the therapeutic value of the electric light cradle corresponds with its theoretical advantages.

Infra-red irradiation, diathermy, and possible other forms of physiotherapy may gain favor in the treatment of distention and gas pains as familiarity with these agents and facilities for their application become more common.

As previously mentioned, the administration of morphine may be found necessary in intractable cases, but a word of warning should be spoken in connection with the repeated administration of morphine in cases in which symptoms of distention and gas pains persist for a considerable period of time. One must not allow intestinal obstruction to develop unrecognized under the mask of narcosis. It must be emphasized again that postoperative distention and gas pains are self-limited conditions; complete absorption of gas is a matter of hours rather than days, and persistence of symptoms for more than from thirty-six to forty-eight hours should

stimulate a study of the case for some unrecognized intra-abdominal abnormality to account for a possible incipient ileus.

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Chapter IX

DILATATION OF THE STOMACH

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Chapter IX

DILATATION OF THE STOMACH

1. Dilatation of the Stomach

A. Etiology: Dilatation of the stomach may occur postoperatively in connection with any of the more radical operative procedures; it is rarely encountered as a complication of surgical manipulations which have not involved abdominal section, and it occurs most frequently in connection with gastric operations, biliary surgery, and operations on the female pelvis. The mechanism of the development of the condition is not well understood.

In connection with a possible etiological relationship between the Fowler or "semirecumbent" position and the development of gastric dilatation, Gibson and Wade[1] have compared two series of cases, one in which the ordinary flat position was used and the other in which the Fowler position was maintained. The range of operative procedures considered in the report was limited to surgical manipulations in the upper portion of the abdomen. The criterion used as to the existence of gastric dilatation was, however, the fact that gastric lavage had been performed. In the use of this doubtful criterion the incidence of gastric dilatation was significantly less in fully recumbent patients, and especially so in patients submitted to biliary surgery. The incidence of pulmonary complications was, however, slightly increased (2 per cent).

Two theories of gastric dilatation have been proposed; (a) one assumes that the dilatation of the stomach is secondary to mechanical obstruction high in the small intestine, (b) the other postulates a condition of paralytic ileus involving the stomach wall and possibly the upper part of the small intestine as well.

As possible causes of mechanical obstruction the rôle of (1) constrictions at or about gastroenterostomy openings and

(2) the production of duodenal ileus are most frequently considered. It is easy to understand how edema about the margins of an artificial stoma between the stomach and intestine might cause virtual obliteration of such an outlet to the gastric contents, or to picture a kinking of the intestine in the neighborhood of such an opening which might produce a similar obstruction. The occurrence of gastric dilatation is not, however, confined to cases in which gastroenterostomy has been performed and consequently such mechanisms cannot be considered as explaining all cases.

It has also been suggested that the etiology is sometimes similar to that found in certain cases of "duodenal ileus" in which there is a mechanical drag of the superior mesentery artery on the last portion of the duodenum, thus producing mechanical constriction of the lumen of the gut at that point. Whereas, however, this factor may be present in the later stages of gastric dilatation in which the weight of the gastric contents already present transmits traction on the mesenteric artery, the clinical picture of the two conditions is so different that the etiology cannot be fundamentally the same.

By a process of exclusion, therefore, and in the absence of other possibilities, one must assume that most cases of gastric dilatation represent essentially a paralysis of the muscular coats of the stomach, and this is the view most commonly held. The essential etiology of this paralysis is not known though, most probably, it consists essentially of some kind of intoxication.

To suggest, as some have done, that the dilatation is secondary to functional obstruction which is essentially reflex in character is to elucidate matters not at all.

B. Clinical Diagnosis: Dilatation of the stomach usually occurs, or at least becomes clinically recognizable, within from twenty-four to forty-eight hours postoperatively.

The patient, who in the interim characteristically may have been observed to have vomited slightly more than patients ordinarily do as a result of taking an anesthetic, begins to

complain of a sense of epigastric fullness and distress and also to evacuate from the mouth quantities of thin brownish or greenish-black fluid. This fluid may be blood tinged in cases in which the intestine itself has been opened. The manner of the evacuation of this fluid is an important consideration in the recognition of the condition because the material in gastric dilatation is not vomited in any proper sense of the term but flows out of the mouth without much effort, a process which has been rather aptly described as "overflow vomiting." Furthermore, the evacuation of this material does not give the patient relief, and as time goes on the flow of stomach contents out of the corner of the mouth and over the cheek becomes virtually continuous.

Physical examination at this time shows on inspection considerable distention of the abdomen especially in the left upper quadrant and on percussion a large area of dulness corresponding to the outlines of the dilated viscus.

The passage of a stomach tube at this time reveals the presence of a large quantity of fluid in the stomach, often as much as two or three liters; the fluid obtained has, of course, the same physical characteristics as the material vomited. Careful measurement over a relatively long period of time of the amounts of material recovered by stomach tube and the amount of fluid intake which the patient is able to negotiate will show in a case of gastric dilatation that much more is regurgitated than is received, thus demonstrating that the stomach contents are actively secreted and do not represent material taken by mouth.

Due to excessive regurgitation dehydration rapidly ensues in cases of gastric dilatation not successfully treated, thirst becomes excessive, and the urine becomes scanty and highly colored. Collapse, characterized by the development of a rapid, thready pulse, a cold and moist skin, and shallow respirations, rapidly supervenes.

c. TREATMENT: Lavage is the treatment *par excellence* in these cases and should be instituted as soon as the diagnosis

is even suggested. Lavage may be repeated every six hours, or as frequently as necessary to keep the stomach quite empty, or, better still, a tube of the Jutte or Levin type may be introduced into the stomach and left permanently *in situ*. The free end of the tube in the latter case is allowed to drop over the edge of the bed to produce a siphonage action, and a syringe is attached and suction applied at frequent intervals to make sure that the apparatus has not become clogged.

It has been suggested that it is often possible also to place the patient in a modified knee-chest position with the hips elevated to a higher level than the head, thus favoring mechanical emptying of the stomach through the esophagus and mouth; but such a procedure is usually inconvenient, sometimes not feasible, and is rarely necessary.

Nothing should, of course, be given by mouth, but relatively large quantities of normal salt solution should be given hypodermically and intravenously. Morphine is indicated for the relief of abdominal distress.

D. PROGNOSIS: Untreated, many patients die of gastric dilatation. When the condition is recognized early, however, and is properly and energetically treated all patients recover.

II. THE USE OF THE STOMACH AND DUODENAL TUBES

The use of both stomach and duodenal tubes, especially the stomach tube, constitutes a very important adjunct to the treatment of a rather considerable number of postoperative surgical cases. The use of gastric lavage as a routine measure in all cases receiving general inhalation anesthesia has already been discussed, and although it is not perhaps usually considered necessary or even advisable to construe the proper use of gastric lavage too broadly, patients as a rule undoubtedly do better when the stomach is kept clean by artificial means. Gastric lavage is usually indicated one or more times in all cases of upper abdominal surgery; so true is this that in cases of biliary and gastric surgery, at least, the medical attendant should become accustomed to reaching for the stomach tube

almost by instinct whenever the condition of the patient shows a tendency to become unsatisfactory.

A. INDICATIONS FOR GASTRIC LAVAGE: The indications for gastric lavage consist (1) in the presence within the stomach of gas, blood, undigested food, bile and intestinal contents regurgitated from the small intestine by a process of reverse peristalsis, and (2) in the presence within the stomach of abnormal secretions derived from the stomach wall itself. The recognition of the presence of such substances within the lumen of the stomach is not always easy clinically. Distention in the region of the costal angle is always presumptive evidence of dilatation of the stomach, and persistent vomiting or vomiting presenting the characteristics described as "regurgitant," i.e., the type in which bile stained dark colored material flows out of the mouth and over the cheek without apparent effort, presents additional evidence of the development of dilatation. Not infrequently, however, the condition of the patient raises no suspicion of gastric dilatation, the only indication of the presence of foreign material within the lumen of the stomach being such vague symptoms and signs as restlessness, a drawn countenance, epigastric discomfort, rapid pulse, or merely an indefinite feeling that matters are not going as well as they should.

Patients after recovery from a general inhalation anesthesia are expected to vomit once or twice, and mild nausea is expected to persist for three or four hours. Repeated vomiting and unduly severe or prolonged nausea in the absence of actual vomiting constitute presumptive evidence of gastric irritation secondary to the presence of toxic secretions, and gastric lavage should be invariably performed in such cases.

B. TECHNIQUE OF GASTRIC LAVAGE: Gastric lavage can be a relatively simple and clean procedure or an obnoxious, soiling, and unpleasant one depending partly upon the cooperation which the patient is able or willing to give and partly upon the technical skill of the attending surgeon. The passage of a tube through the esophagus into the stomach is, even at best, not a

particularly pleasant proceeding for the conscious patient. The most difficult part of the entire performance is the passage of the end of the tube through the fauces and into the first part of the esophagus. The tolerance of the palate, nasopharynx, and pharynx of patients to mechanical stimulation varies considerably, and an amount of stimulation which may cause no unappreciable degree of discomfort to one person may be absolutely intolerable to another.

Other things being equal, the amount of such stimulation will depend to a considerable extent upon the size and pliability of the tube selected for use. A large stiff rubber tube unskilfully forced through the fauces will often throw the pharyngeal muscles of even a tolerant person's throat into so violent a spasm that the respiratory passsage becomes occluded, violent choking and gagging ensue, the face becomes cyanotic, and the patient either tears the tube in terror from the attendant's hands, or if restrained so that this is impossible, promptly projects the contents of his stomach through the tube with such violence as to soil himself, the bed, and very likely the attendants as well. Smaller and more pliable tubes are less likely to cause inconvenience, but really small tubes cannot always be used because not infrequently the stomach contains particles of food or blood clot, or conglomerations of mucus which require removal and which cannot be evacuated through such a tube because of the small size of its lumen. One of the advantages of routine gastric lavage on the operating table and before the patient has recovered from the effects of the anesthetic is that lavage with a relatively large tube is customarily required but once, and if this be performed while the patient is unconscious particulate stomach contents are removed thereby and a relatively small tube may be used subsequently in the event that lavage becomes desirable after consciousness has been regained. The size of stomach tube to be used in any given case depends, thus, on the character of stomach contents requiring removal, and when possible very

small flexible tubes especially tubes of the Jutte or Levin type are preferred.

Stomach tubes must, of course, be sterilized prior to use, and if possible should be free from stains and unsightly marks because of the unfavorable psychic effect which such factors may have on the conscious patient. Tubes are tolerated best when thoroughly chilled, and they are therefore placed on ice after being sterilized, and, as before, in selecting the basin and preparing the ice a favorable psychic effect is to be sought whenever possible.

Patients swallow best when in the upright or partially upright position, and whenever feasible should be allowed to sit up in bed properly supported, of course; or if this is impossible the head should be at least slightly raised from the pillow. In connection with this procedure a rubber bib, rubber sheet, or similar protective device is arranged about the patient's neck and down over the chest and bed clothing to prevent possible soiling of the patient and his linen.

Patients usually submit to gastric lavage best if they are previously appraised of just what is to be done and exactly what is to be expected of them. They are told that they are to be caused no pain, but that the procedure about to be performed may cause them to gag and that this tendency may be overcome by assisting all they can in swallowing the tube and in resisting any inclination to expel it by focussing the attention on breathing through the mouth.

When passing the tube the operator stands either directly behind or at the side of and slightly behind the patient, steadies the head of the patient with one hand and introduces the end of the tube, previously well lubricated with some suitable lubricant, through the fauces and directly into the pharynx without touching the soft palate, the pillars of the fauces, or the uvula. The introduction of the tube should be continued into the esophagus neither too rapidly nor with too much deliberation, the movement being executed steadily and no attempt being made to force the procedure. During this pro-

cedure the patient should be reassured and encouraged to swallow, but if gagging ensues the tube is temporarily arrested in its course and the patient is admonished to breathe through the mouth in short quick gasps, after the manner of the panting of a dog.

Once an attempt has been made to pass the tube every effort should be made to avoid withdrawing it because if initially unsuccessful in completing the procedure subsequent attempts may be increasingly difficult.

Patients have difficulty in swallowing a tube coated with vaseline or other frankly oily materials, and especially materials having distinctive odors or tastes. Unflavored water-soluble lubricating jellies or glycerine make the most suitable substances for lubricating purposes.

Once the tube has passed into that part of the esophagus possessed of involuntary peristaltic activity no further difficulty should be encountered.

In cases in which the passage of the tube is well tolerated spontaneous vomiting does not occur through the tube, and suction must be applied to the free end of the tube to start evacuation of the stomach. Suction may be applied by means of a syringe or siphonage suction may be employed in suitable cases by first completely filling the tube from its free end with water and then quickly lowering this end of the tube below the level of the stomach.

The stomach after the primary evacuation has been completed should be alternately filled with cleansing solution and reemptied until the material obtained shows no further evidence of contamination. Plain water at a temperature of from 110 to 120° F. may be used for this purpose, though a 1 or 2 per cent sodium bicarbonate solution usually serves somewhat better because it favors the liquefaction and dislodgment of any mucus that may be present.

c. Continuous Gastric Drainage (Jutte Tube): Under certain circumstances there occurs in the stomach postoperatively an accumulation of gas, intestinal contents, or a com-

bination of both which tend to become continually augmented and therefore presents indications for continuous removal. Such an accumulation occurs characteristically (a) in gastric

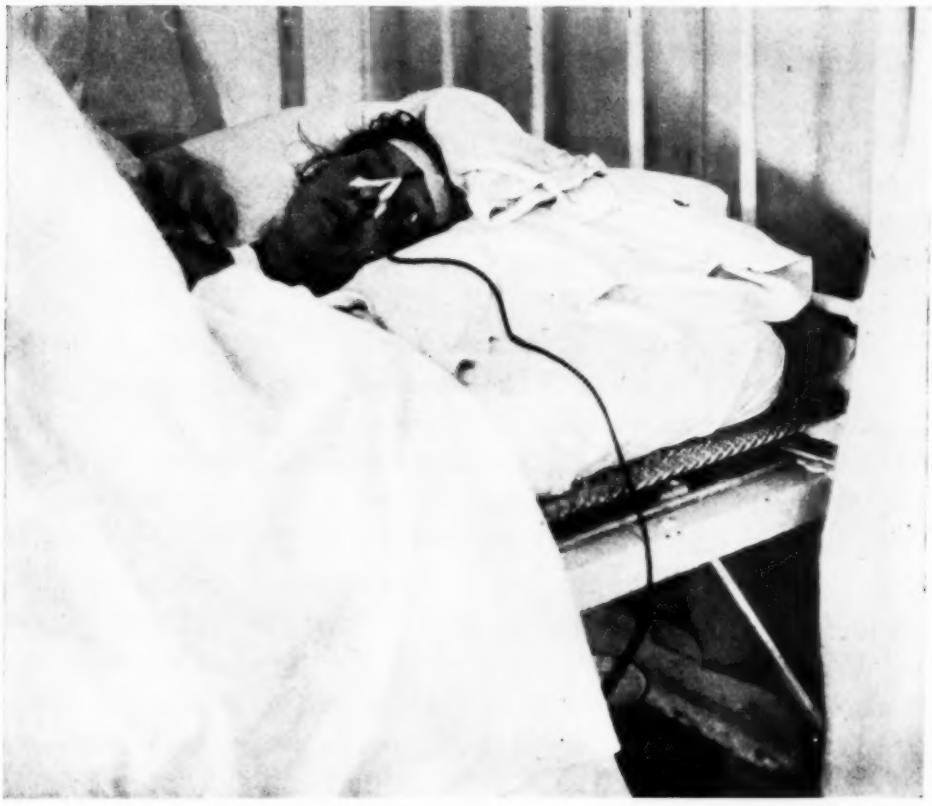

FIG. 46. Use of continuous gastric lavage. A small stomach tube has been passed through the nose. Tube has been fastened in place to bridge of nose and forehead by strips of adhesive plaster. Free end of tube drips into receptacle on floor.

dilatation in which the accumulation represents mainly an abnormal secretion from the walls of the stomach, (b) in intestinal obstruction, whether paralytic or dynamic, in which case reverse peristalsis carries material antiperistaltically from the intestine to the stomach, (c) in various reflex irritative conditions especially such as are connected with gall-bladder disease, and (d) in certain aggravated cases of abdominal distention, the accumulation in this class of cases consisting mainly of gas.

The repeated passage of a stomach tube for purposes of withdrawing such accumulations is irksome to the medical attendant, unpleasant for the patient and relatively inefficient as a method, since during a considerable period of time between successive passages of the tube variable amounts of material are left within the stomach cavity. In all of these types of cases continuous drainage is much more rational and is easily provided by means of the introduction of a stomach tube of small caliber through the nose (Jutte tube), which tube can be left in situ for as long a period as may be indicated by the mode of progress of the case, occasionally for days (Fig. 46).

The distance from the incisor teeth to the stomach in the adult is about 15 in. and this distance is usually marked on tubes designed for purposes of gastric lavage; an inch or two in excess of this length is allowed when tubes are introduced through the nose.

The tube used may be provided with a perforated tip or "sinker" of metal or the Levin catheter type of tube may be used and perforations are also provided in the wall of the tube for a distance of 2 in. or so proximal to the metal or rubber tip in order to allow additional drainage. After being introduced the tube is anchored to the cheek of the patient with suitable strips of adhesive plaster. Its free end is made of sufficient length to hang over the edge of the bed and is arranged to empty into a suitable bottle or other receptacle, the latter being either placed on a low stand beside the bed or hung therefrom.

The Jutte, or Levin, tube because of its small caliber allows only the passage of gas and fluids and is not suitable for use in cases in which blood clot and relatively large pieces of undigested food and other debris require removal. It does not interfere with the passage through the esophagus into the stomach of liquids taken by mouth; consequently water and other liquids either hot, cold, or tepid as may be desired may

be given the patient to drink and may be just as readily withdrawn or expelled through the tube if so desired.

If a siphonage action be started by suction applied to the free end of the tube, fluid will continue to flow from the end of the tube as long as it is provided by mouth and in this way a continuous gastric lavage may be instituted. By this method there is provided a very ready means of applying heat to the body or withdrawing it therefrom, since such a process (as suggested by Matas[2]) virtually converts the stomach into a hot water bottle or an ice bag as the case may be. The stomach lying as it does just below the heart, and being in intimate relation also with the liver, vena porta, vena cava and aorta is ideally located for the purpose, and the degree of regulation of body temperature which can be gained by this procedure is remarkable.

D. The Postoperative Use of the Duodenal Tube: That toxins absorbed by the upper portion of the intestine are responsible for acute dilatation of the stomach and occasionally hiccough is held by many, and that absorption of any other toxic product which may be present in the gastrointestinal tract is more rapid from the small intestine than from the stomach has been recently asserted.

Soresi[3] believes that a certain number of patients succumb postoperatively as the result of absorption of stagnated duodenal contents. He has found experimentally that dogs which have undergone gastrectomies develop a more or less distended paretic condition of the duodenum, which latter is found filled with a chocolate colored fluid even in the absence of any obstacle or obstruction to the passages of this fluid in either direction. He believes that the clinical condition noted in the case of certain patients who fare well for three or four days following operation and in whom the pulse thereafter becomes irregular, more frequent and small, the temperature subnormal, and the skin clammy and covered with cold perspiration is due to absorption of this material. Usually, he believes, the absorption of this material is not accompanied by noticeable ill

effects, but holds that patients who have undergone severe operations on the organs contained in the upper right quadrant of the abdomen, being characteristically in a poor general condition, not infrequently succumb as the result of toxemia so induced.[3] Fortunately the duodenum as well as the stomach can be drained with facility.

The method of transduodenal lavage was originally described by Jutte, in 1912,[4] as a method of value in the treatment of certain chronic medical diseases. Surgeons were not slow, however, to adapt the principle to their own purposes in the postoperative care of surgical patients, and this method has come to be quite generally recognized as of value in the treatment of certain surgical exigencies.

Jutte[5] has very aptly compared the cleansing effect of transduodenal lavage of the small intestine to the use of the enema in evacuating the colon. The advantages of transduodenal lavage over gastric lavage consist mainly in the avoidance of irritation of the gastric mucosa which is prone to eventuate in vomiting and in the fact that by the technique under discussion a part of the intestine presumably concerned directly with (a) the absorption of toxic substances on the one hand, and (b) with the absorption of fluids on the other is rendered immediately accessible.

The useful purposes subserved by the proper use of the duodenal tube as listed by Oden[6] include the following:

1. Relief of distention.
2. Prevention of nausea.
3. Removal of toxins.
4. Supplying of fluid.
5. Instillation of therapeutic agents.

The armamentarium required for transduodenal lavage by the Jutte technique is relatively simple, consisting of a $\frac{1}{16}$ in. thin-walled duodenal tube with a metal olive attached at the end, the tube being itself perforated in the region of the olive, and a suction apparatus which may consist simply of an

ordinary syringe, and some means of irrigating through the tube, either a funnel or possibly a syringe.

The patient swallows the duodenal tube, turns on his right side on the table or bed, and drinks a glass of water. The water distends the stomach slightly and favors the gravitation of the metal olive to the region of the pylorus; within about twelve hours peristalsis carries the olive through the pylorus into the duodenum. By aspirating from time to time and noting the appearance of the aspirated material, one may judge the position of the olive and perforated part of the duodenal tube. Jutte[5] says that except in cases of gastric catarrh the aspiration of material which is stringy or tenacious indicates that the area being drained is intestinal and not gastric, and he thinks this test is more valuable than tests for acidity with litmus paper, since on the one hand the contents of the duodenum may show a temporary acidity due to massive evacuation of stomach contents just previously, or on the other hand the gastric acidity may have been almost or completely neutralized by regurgitation of duodenal contents through the pylorus.

The duodenal tube serves one useful function not available in connection with the ordinary stomach tube. The stomach, as mentioned elsewhere, absorbs fluids to only a very slight degree if at all; the duodenum, however, absorbs them readily; consequently the introduction of fluids for purposes of absorption is much more likely to succeed in connection with duodenal intubation. The administration of fluids by "duodenal drip" is frequently very successful. Such a tube may be left *in situ* for as long as seven days if desired, but because of the possibility of the formation of pressure ulcerations along the course of the tube and more especially about the terminal metal olive the tube should not be allowed to remain longer than necessary.

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